

Government Museum, Chennai



Dr. R. KANNAN

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A Guide to The Exposition on the Progress of Industries and Handicrafts of Tamilnadu

Government Museum, Chennai

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Front Cover : The picture symbolises the psychomotor abilities of Man. He uses natural resources and his hands to perform work, creating handicrafts and later on mass manufacture through Industrial applications. The invention of the wheel and understanding of the use of power enabled him to manufacture several commodities and build structures for his convenient living as well as for earning his livelihood.

Back Cover : The five elements of nature - air, water, fire, earth and ether (space) are depicted in the picture. The five primordial element theory (*pancha- mahabhootas*) is as old as *Hinduism*. These elements are responsible for the formation and existence of the Cosmos. They are the components of energy transforming into physical matter - stars, planets etc., The universe is supposed to have started as an egg (*Brahmanda- Sanskrit*). Modern physics agrees with this view. Industries have developed on the theory of transforming one form of matter through application of energy into another.

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FOREWORD

South India is the cradle of civilisation. It has been stated that civilisation existed here more than 10,000 - 15,000 years ago. The Government Museum, Chennai is one of the great museums of the world. It stands second in India in terms of age and the size of its collection. The completion of the 151st Year of this Museum is a landmark event not only in its history, but also in the world of museology. A series of events were held to commemorate this occasion on the model of the Centenary Celebration held in 1951 AD. About Rs.5 Crores have been spent on electronic surveillance, renovating the museum theatre, the compound wall (both heritage structures) and also the galleries, besides setting up a new gallery, 'Exposition on the progress of Industries and Handicrafts in Tamilnadu'. This book is a guide to the exhibits in this gallery.

The Exposition on the Progress of Industries and Handicrafts of Tamil Nadu is the latest gallery to be set up in the Government Museum, (Madras) Chennai. The main idea behind this Exposition is to show how handicrafts and industries developed from the remote pre-historic past to the present period. This gallery is the brainchild of the President of India, His Excellency, Dr. A.P.J. Abdul Kalam and has been set up under the instructions of the Honourable Chief Minister of Tamil Nadu, Selvi J Jayalalithaa. It was opened on 19-6-2003 on the occasion of the completion of 151 years of the museum by the President of India, His Excellency, Dr. A.P.J. Abdul Kalam.

The progress of civilisation from the pre-historic era and the First Tamil Sangam era is depicted in this gallery. The Second Tamil Sangam era is also considered pre-historic as still no archaeological evidence has been found, though literary references abound. No sites have been excavated through Marine Archaeology. Tamil literature asserts that the Pandya capital, Kapatapuram was washed away in Holocene sea level rises. The historic past starts from the Third Tamil Sangam era. This era starts from circa 900 BC. From the remote era of stone tools to the recent past is a wide canvas, a challenge to any museologist. The method used is thematic cum chronological display.

This gallery has been set up within a very short period of four months using Computer Aided Design and Three Dimensional Modelling in collaboration with Anna University. The virtual model has been translated into reality in-house by the Government Museum, Chennai after overcoming a lot of initial difficulties. The latest materials, methods of display and lighting with the design of German origin (Octanorm type) have been used to create the hi-tech display. All the materials are assembled from different sources, Indian and foreign. This may be the first time such hi tech methods have been used in the world of museums.

Documentation of the collections is an important work of a Museum as a purveyor of knowledge in addition to entertaining visitors. The Government Museum, Chennai, has a tradition of original and path breaking publications to its credit. There are publications which are considered path breaking. These include works by the Directors of the Museum right from the 19th Century AD like Dr. George Bidie, Dr. Thurston, Dr.F.H.Gravely, Dr. Aiyappan, T.N. Ramachandran, C. Sivaramamurthi, Dr.S.T.Satyamurti, P.R.Srinivasan etc. Their works have become reference books in their respective fields.

In keeping with this tradition about 18 publications have been brought out for the 151st Anniversary celebrations in record time. These have World-class photography and printing, though the cost is a fraction of even Indian commercial costs for comparable books.

Thiru.K.Lakshminarayanan, Assistant Director of Museums, the first author did a lot of research and fieldwork in producing this guidebook.

Dr. R. Kannan, the Commissioner of Museums, who was also in charge of Archaeology earlier has done this technical work. His technical work and publications have been internationally recognised by his being made an invited Board Member of the Association of International Museums of History at Paris, France. He has shouldered this responsibility in addition to his heavy charge of Agriculture, first as Commissioner and then as Agriculture Production Commissioner and Secretary to Government, Agriculture Department. He has a passion for this work.

Dr. Kannan has written several important books and monographs earlier. Some of these are The Documentation on the Cannons in the collection of the Government Museum, Chennai (1999 AD). The Monograph on Holistic Dating (2000 AD), Iconography of Jain Images in the Government Museum, Chennai (2001 AD) and Iconography of Jain Images in the districts of Tamilnadu (2002 AD). Besides he has edited the Journal of the Museum, written several articles and papers, which have been published among others in the Annual Journals of the museums Association of India and in the 6th International Colloquium of the Association of International Museums of History at Lahti, Finland in 2002. He participated as a representative of the Government of India and Tamil Nadu in the Regional Meeting of Experts in Museology of Asia Pacific Region held from 5th to 9th December 2003, organised by the Post Graduate Institute of Archaeology (PGIA), University of Kelaniya at Colombo, Sri Lanka, supported by UNESCO and presented a paper on 'Training needs of Indian museums' and Power Point Presentation on 'Chennai Museum Before-After; Conservation of buildings and Refurbishment of galleries'

A second invitation was issued to him in his personal capacity to participate and present papers on 'Has the Internet Created a Divide Between Rich and Poor Museums' and "How to present colonial history from different points of view; Smother or Hybridise?"- They were presented as keynote papers along with a Power Point presentation at the 7th International Colloquium of the Association of International Museums of History at Sao Paulo Brazil, from 21-28th March, 2004. They were read out in absentia.

He is in the expert committee on use of power tools set up under aegis of the Indian Institute of Technology, Chennai. He has also participated and contributed papers in International Seminars on Conservation. He has written, edited and published several colourful brochures on the museum and its several galleries.

In addition Dr. Kannan has been giving technical advice when sought on how to renovate the heritage structures like the theatre, compound wall etc., so that it is done by the Public Works Department according to Archaeological principles. He was the only person to correctly identify the red stone used in the compound wall and the National Art Gallery building as Satyavedu (Andhra) stone and not Rajasthan stone as was thought by even Engineering research scholars.

The publications made for the 151st Anniversary (2002-2003) apart from this book are:

1. Manual on the Numismatics Gallery in the Government Museum, Chennai.
2. Monograph on the Rock and Cave Art Gallery in the Government Museum, Chennai.
3. A Manual on the Holographic Gallery in the Government Museum, Chennai.
4. Documentation of the text of Son-et-lumière on the Rock and Cave Art Gallery in English and Tamil (2 books).
5. Documentation of the text on the Video clips on the touch screen on the Rock and Cave Art Gallery.

6. Souvenir - 2003
7. Manual on the Bronzes in the Government Museum, Chennai.
8. Iconography of Jain Images in the districts of Tamil Nadu (covering the Museums of the Department of Archaeology and Museums)
9. சித்த மருத்துவத்தின் சிறப்புகள்

Brochures

1. Rock and Cave Art Gallery
2. Botany Galleries
3. Bronze Gallery

Videos

1. Bronze making
2. The Museum through the ages (from the 1950s till the present)
3. Retrieving from the Archives the movie on the museum produced in 1971, converting it into CD and subtitling it in English.
4. Rock and Cave Art
5. Video on the museum in general (present)
6. History of Industry and Handicrafts in Tamilnadu.

The publications have been listed so that if some of them are lost in the future then, this list will be valuable. This is the first time in the history of any museum that so many publications are being brought out within such short span of time of about six to eight months. This is apart from the work of setting up and reorganising galleries referred to above.

This guide covers a wide spectrum period from pre-history to the recent past as it reflects the exhibits in the gallery. Research work has been done on diverse subjects like pre-historic stone tool and pottery making, textiles, handicrafts, jewellery, different modes of transport, communications, iron making, chemicals etc right down to the latest atomic energy and space craft. The documentation has been done with reference to Tamil Nadu. This makes it a valuable specialised reference material.

I compliment Thiru. K. Lakshminarayanan and Dr. Kannan who as a team along with others have made this prolific output of publications possible, which is efflorescence within a short period of time for the Government Museum, Chennai. The enormous reference work for this publication has been done painstakingly by Thiru. K. Lakshminarayanan, who is retiring in May, 2004. I wish him a long and happy retired life and many more such contributions in this field.

I am sure that this book will be a valuable reference work in the field in the years to come.

Fort St. George,
Chennai-600 009
31-03-2004


(Lakshmi Pranesh)



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PREFACE

The Exposition on the Progress of Industries and Handicrafts of Tamil Nadu is the latest gallery to be set up in the Government Museum, (Madras) Chennai. The main idea behind this Exposition is to show how handicrafts and industries developed from the remote pre-historic past to the recent period. This gallery is the brainchild of the President of India, His Excellency, Dr. A.P.J. Abdul Kalam and has been set up under the instructions of the Honourable Chief Minister of Tamil Nadu, Selvi J Jayalalithaa. It was opened on 19-6-2003 on the occasion of the completion of 151 years of the museum by the President of India, His Excellency, Dr. A.P.J. Abdul Kalam. The function was also attended by His Excellency, the Governor of Tamil Nadu, Thiru P.S. Ramamohana Rao, Honourable Chief Minister of Tamil Nadu, Selvi J Jayalalithaa, the Honourable Minister for Education, Thiru S. Semmalai and leading citizens of Chennai.

This gallery reflects the development of civilisation from the pre-historic era and the First Tamil Sangam era. The second Tamil Sangam era also pre-historic has still no archaeological evidence. The sites have not been excavated through Marine Archaeology, though literary accounts say that the Pandya capital, Kapatapuram was washed away in Holocene sea level rises. The historic past starts from the Third Tamil Sangam era. This era starts from circa 900 BC. From the remote era of stone tools to the recent past is a wide canvas, a challenge to any museologist. The method used is thematic cum chronological display.

This gallery has been set up with in a very short period of four months using Computer Aided Design and Three Dimensional Modelling in collaboration with Anna University. The virtual model has been translated into reality in-house by the Government Museum, Chennai after fixing the usual teething troubles. The latest materials, methods of display and lighting with the design of German origin (Octanorm type) have been used to create the hi-tech display. All the materials are assembled from different sources, Indian and foreign. This may be the first time such advanced methods have been used in the world of museums.

Chennai - 600 008.

25-03-2004

(Dr. R. KANNAN, Ph.D., I.A.S.)

To

The memory of late Sri T.S. Padmanabha Iyer (Retd.) Superintending Engineer (P.W.D.) British India & Composite Madras State, my grandfather on his centenary (1901-2001) and my uncle late Sri P. Subramanian. Also to Ms. Lalitha, my mother, Mrs. Seetha, my wife, Master Sridar Padmanabhan, my son and Ms. Shrikala, my daughter for their encouragement and help.

Dr. R. Kannan, Ph.D., I.A.S.

To

My parents Thiru. R. Kandasamy and Tmt. K. Chandra and my teachers.

K. Lakshminarayanan

Acknowledgement

We acknowledge the help rendered by Thiru. J.R. Ashokan, Thiru. K. Sekar, Tmt. A. Premadeepa Rani, Thiru. R. Balasubramanian, Thiru. M. Mohan, Curators and Tmt. S. Thara, Personal Staff of the Commissioner. We also acknowledge Thiru. G. Ramesh, Technical Assistant of the Chennai Museum for his hard work in preparing nice digital photographs for this publication.

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Views of Gallery Display



Views of Gallery Display

GUIDE TO THE INDUSTRIES AND HANDICRAFTS GALLERY

INTRODUCTION

This gallery was set up in deference to the wishes of the President of India, His Excellency, Dr. A.P.J. Abdul Kalam and has been set up under the instructions of the Honourable Chief Minister of Tamil Nadu, Selvi J Jayalithaa. It was opened on 19-6-2003 on the occasion of the completion of 151 years of the museum by the President of India, His Excellency, Dr. A.P.J. Abdul Kalam.

It adopts a thematic cum chronological display. It starts from the earliest remains of the Palaeolithic Age of Tamil Nadu (1,25000 - 500000 years).

DEVELOPMENT OF STONE TOOLS, POTTERY AND CERAMICS

An overview

The first theme as seen in the diorama shows how human beings made tools for hunting and gathering food. This created food surplus, which enabled them to have the leisure to think. This in turn created more progress. The first few showcases show the fashioning of tools from stone in the Old Stone Age i.e. the Palaeolithic period. These tools are crude. In this period, unburnt clay pottery developed. Then the Middle Stone Age (Mesolithic) and New Stone Age (Neolithic) periods of smooth and advanced tools are shown. These are arrow type, axe type etc., made of stones. This was followed by the Megalithic period when the historic era starts. This is also displayed. The discovery of the wheel and fire is a landmark in the development of the human race. This meant pottery became burnt clay pottery. Human beings started making fired pottery, first the redware, then black and redware with slip and then painted greyware, this was followed by ceramics. The theme is, therefore, the development of pottery. This chronology of depiction is borne out with reference to the Indus Valley civilisation. A similar chronological sequence is seen in Tamil Nadu as found out during archaeological excavations.

This autarchic period was followed by later periods of interaction with western culture especially Rome and Greek through Persia and the sea. Highly polished ceramic ware came to be produced. Several centuries later interaction with the Europeans in the 19th century AD resulted in their methods of production being brought to Tamil Nadu. This resulted in stoneware and

bone china being produced. Mass production of ceramics started. The last showcase in this series depicts the latest highly advanced technology of Investment Casting in which ceramics is used for coating the castings. It combines and fuses into metallurgy

Development of Stone Tools, Pottery and Ceramics

An elaboration

The development of psychomotor abilities of prehistoric men enabled them to complement the inadequacy of their natural abilities by means of objects held in their hands. These capabilities elevated human beings above other species of the animal kingdom. From their skillful hands emerged various crafts, which in course of time led to the formation of industries in the advanced societies of later periods. The primitive technological activities of prehistoric men were linked with the acquisition of food. In this endeavour to get his food the hands of human beings played an increasingly active and varied role. Stone, bone and wood became the first core materials for the prehistoric men to produce food gathering tools and hunting weapons.

The evolution of manufacturing techniques of stone implements started from the earliest flaked stones to the implements that were copied by the first metal tools of megalithic periods from about 3000 BC. This unified evolution of stone chipping techniques and the linkage of various stages demonstrate one of the most persistent factors in the history of technology namely, that innovations are born by the addition of new operations to earlier achievements, which then serve as substrata. The significance of this evolution emerges in the relationship, which is established in every period between the manufacturing process and the technical efficiency of the implements obtained.

Prehistoric Stone tools of Tamil Nadu

Of the several stages of man's progress in civilisation, Robert Bruce Foote, the father of Indian Prehistoric Studies, recognises four major stages that occurred in the Indian Prehistory. They are:

1. Palaeolithic (Old Stone) Age
2. Neolithic (New Stone) Age

3. Early Iron Age
4. Later Iron Age

Later Prehistorians added one more division, the Mesolithic (Middle stone) period in between the Palaeolithic and Neolithic ages. Mesolithic age is otherwise called as Microlithic Age in view of the use of micro stone tools by the people of that age.

Palaeolithic Tools

The earliest known manmade artefacts, the stone tools belong to this age. All the implements used by men at that age were of hard stone. They were prepared by chipping with other stones so as to give them a sharp edge. Their surface was left rough. As per South Indian anthropologists, the Palaeolithic period of South India is about 1,25,000 to more than 5,00,000 years old (Jayadev C.J., 1964). During this period man was a hunter and food gatherer. In South India these tools have been obtained in numerous localities from the beds of laterite rocks. *Attirampakkam* near Poondi in Tiruvallur district is one of the important Palaeolithic sites in South India. Of these tools the well-known ones are hand axes. During recent excavations at this site in 2002-03, we found a fossil root of a tree and several tools. Most of the stone tools from this site were made of quartzite, a common feature of South Indian Palaeolithic stone tools. They had been made from pebbles of suitable size by removing large places from the top and bottom surfaces. They were not provided with handle but were held in hand when used. So, they got the name hand axe or *coup-de-poing*. But it is better to refer them as biface (Maurica Dumas, 1969). Cleaver is another type of Palaeolithic tool. They are flat axe like tools with a broad cutting edge, formed by the intersection of two flaked surfaces included to one another at a small angle. They were usually made from flakes rather than from pebbles. They can only be made from quartzite and not from flint. During the second phase of the Palaeolithic period, finer hand axes or ovates were made. Scrappers were made from large flakes. They have a convex cutting edge running along on one side only and the other side was kept blunt. They were used for skinning animals (Jayadev C.J., 1964).

Mesolithic Tools

At the closing phase of the Palaeolithic age, people began to make small flake tools of agate, chalcedony, chert, carnelian, jasper, obsidian and quartz. These tools were fitted in series

to a handle and were used for cutting. On account of their small size they are referred as microliths. These microliths are in various forms and called as blade, burin, lunate, triangle etc. As the Microlithic age occupies a position in between the Palaeolithic and Neolithic ages, it is otherwise called as Mesolithic. But these tools survived in the later Neolithic phases also. Microliths are dated to before 10000 BC (Jayadev C.J., 1964).

Neolithic Tools

Neolithic people perfected the art of stone tool making. The stone axes and adzes of this period are well shaped and polished and the edges shaped by grinding. The polished stone axes or Celts were hafted or provided with handles of wood or bone and used. Neolithic Celts were made in various types ranging from thick axes almost circular in cross section to flat chisel like tools, which are sharp at both the cutting edge and at the butt end. They were made of hard rocks such as diorite or basalt. Exceptionally few were made with fine-grained sandstone. The making of fine Celt was done in three stages. First a piece of rock was selected and roughly chipped in to form. Then it was pecked, that is angularities formed due to chipping were broken down. In the third stage, the celt was ground and all the roughness smoothened away. Now it was ready for inserting in the handle. The typical Neolithic Celt has a broad rounded cutting edge and pointed butt with oval cross section. This is the prototype of the early hoe blade of iron. The first metal tools, which were made during the Bronze Age, are considered to be the copies of this type. The Neolithic Age in India is dated between 6000 and 4000 BC. There are places at the same time when bows and arrows were used, since the Ramayana is dated to about 7000 BC or 4500 BC (Kannan, Dr, R, 2000). Neolithic habitations in Tamil Nadu have been identified in Krishnagiri, Dharmapuri, Salem and North Arcot districts.

In the Neolithic period, early man's attention turned towards the earth. Both agriculture and the production of clay objects are the two important achievements of this period. The main reason for the development of clay objects in Neolithic and the subsequent agriculture and proto-agriculture periods are the need for various types of utensils required for harvesting, handling, storage and cooking of grains and cereals. A part of these needs was met by baskets and bark vessels and the others by utensils of dried clay in the beginning. In addition to the growing need for containers for storing grains and water, nomadic agriculture gave way to settled agriculture.

The people then felt the necessity of permanent dwelling places for their settled life pattern. They began to construct first huts of mud and thatch and then houses using a combination of mud bricks, burnt bricks, wood and tiles. In the construction of both they used dried clay first.

During Neolithic age the primitive people came to know and use such revolutionary changes as agriculture, the wheel, the domestication of animals, spinning and weaving, living in permanent settlements and making and using pottery and fire.

In the early Iron Age, the art of smelting and working iron was discovered and developed. This was the greatest advance made in arts and crafts. In the later Iron Age people began to use three more metals, gold, copper and tin. They also learned how to make the most useful and important alloy bronze. Lead and silver also came to be known by this time.

Catalogue of Exhibits

1) Name of the exhibit : Hand Axe

Acc.No. : PH 1/2003

Provenance : Tamil Nadu

2) Name of the exhibit: Hand Axe

Acc.No. : PH 2/2003

Provenance : Tamil Nadu

3) Name of the exhibit : Hand Axe

Acc.No. : PH 3/2003

Provenance : Tamil Nadu

4) Name of the exhibit : Hand Axe

Acc.No. : PH 4/2003

Provenance : Tamil Nadu

5) Name of the exhibit : Hand Axe

Acc.No. : PH 5/2003

Provenance : Tamil Nadu

6) Name of the exhibit : Blade

Acc.No. : PH 6/2003

Provenance : Tamil Nadu

7) Name of the exhibit : Blade

Acc.No. : PH 7/2003

Provenance : Tamil Nadu

8) Name of the exhibit : Blade

Acc.No. : PH 8/2003

Provenance : Tamil Nadu

9) Name of the exhibit : Blade

Acc.No. : PH 9/2003

Provenance : Tamil Nadu

10) Name of the exhibit : Blade

Acc.No. : PH 10/2003

Provenance : Tamil Nadu

- 11) Name of the exhibit : Blade
Acc.No. : PH 11/2003
Provenance : Tamil Nadu
- 12) Name of the exhibit : Blade
Acc.No. : PH 12/2003
Provenance : Tamil Nadu
- 13) Name of the exhibit : Blade
Acc.No. : PH 13/2003
Provenance : Tamil Nadu
- 14) Name of the exhibit : Celt
Acc.No. : PH 14/2003
Provenance : Tamil Nadu
- 15) Name of the exhibit : Celt
Acc.No. : PH 15/2003
Provenance : Tamil Nadu
- 16) Name of the exhibit : Celt
Acc.No. : PH 16/2003
Provenance : Tamil Nadu
- 17) Name of the exhibit : Celt
Acc.No. : PH 17/2003
Provenance : Tamil Nadu
- 18) Name of the exhibit : Celt
Acc.No. : PH 18/2003
Provenance : Tamil Nadu
- 19) Name of the exhibit : Celt
Acc.No. : PH 19/2003
Provenance : Tamil Nadu

- 20) Name of the exhibit : Celt
Acc.No. : PH 20/2003
Provenance : Tamil Nadu
- 21) Name of the exhibit : Megalithic Iron Implement (Big)
Acc.No. : PH 21/2003
Provenance : *Adichanallur*, Tirunelveli District,
Tamil Nadu
- 22) Name of the exhibit : Megalithic Iron
Implement (Small)
Acc.No. : PH 22/2003
Provenance : *Adichanallur*, Tirunelveli District,
Tamil Nadu
- 23) Name of the exhibit : Megalithic Iron
Implement (Sword)
Acc.No. : PH 23/2003
Provenance : *Adichanallur*, Tirunelveli District,
Tamil Nadu
- 24) Name of the exhibit : Megalithic Iron Implement
(Spear Tip, Big)
Acc.No. : PH 24/2003
Provenance : *Adichanallur*, Tirunelveli District,
Tamil Nadu
- 25) Name of the exhibit : Megalithic Iron Implement
(Spear Tip, small)
Acc.No. : PH 25/2003
Provenance : *Adichanallur*, Tirunelveli District,
Tamil Nadu
- 26) Name of the exhibit : Metal Bowl
Acc.No. : PH 26/2003
Provenance : *Adichanallur*, Tirunelveli
District, Tamil Nadu



Diorama showing Prehistoric Men at Work



Diorama Depicting Pot Making



A



B



C



D



E

Prehistoric Tools and Iron Implements

A. Sl. No. 1 - 5

B. Sl. No. 6 - 13

C. Sl. No. 14 - 20

D. Sl. No. 21 - 25

E. Sl. No. 26 - 28

27) Name of the exhibit : Hanging Saucer Lamp

Acc.No. : PH 27/2003

Provenance : Tamil Nadu

28) Name of the exhibit : Hanging Saucer Lamp

Acc.No. : PH 28/2003

Provenance : Tamil Nadu

Pottery

The craft of pottery making emerged during the Neolithic age. In the initial stage coarse potteries were made. They were hand made and were designed on the models of the earlier vessels made from natural objects such as gourds, shells and lotus. The dexterity of the fingers of the primitive potter could be seen in the designs of the potteries.

The accidental discovery of the uses of fire by man improved the manufacturing technology of earthenware. Thus the methods of baking clay objects in fire emerged. This provided a new medium for the artisans of early period to construct houses with fire baked bricks and functional vessels. The objects made with baked earth are otherwise called as Terracotta. Terracotta toys, figures and pots were prepared on a large scale by the people of agriculture and proto-agriculture periods.

The potteries of megalithic and agriculture periods exhibit different types that evolved through the improvement of their workmanship and production technique. Some important types are:

1. Hand Made Pottery
2. Turn-wheel pottery
3. Coarse Pottery
4. Burnished Pottery
5. Rusticated Pottery

Hand made Pottery was made by the simplest method. This method is otherwise known as coil or rope technique. The plastic clay is rolled into a thin, rope like strand, which is then coiled around one, and to form a closed circle upon which the rest of the strand is coiled. This could be built upto the required height. The lines of the coil is then smoothed off both inside and outside. Turn wheel pottery was made by placing a lump of plastic clay in the centre of a flat wheel. The wheel was turned by hand and the object shaped by hand and by tool as the wheel rotated. In this method, potteries were made with more delicacy of form and more symmetrical shapes. To make the surface of the pottery shining, burnishing was done. In burnishing, the surface of the pottery

was polished using spatula of wood or bone while the pottery was still in leathery green state. Rustication is for roughening the surface. It was made both for aesthetic decoration and to provide grip for holding them.

The history of pottery cannot be related chronologically and the stages of its progress are few. First he acquired the knowledge that clay could be made into any desired shape and that drying hardened it. Later they also learnt that the hardness of clay objects could be materially increased by baking them in the fire. The production of potteries developed as an important village cottage industry. At the dawn of civilisation, the coarse potteries were fired at a low temperature (about 700° Centigrade) and due to this factor they were porous. They are referred as earthenware potteries.

In course of time a hard non-absorbent pottery and its production technique were discovered. They had improved ability to hold water and food securely. Stoneware potteries were fired at a higher temperature (about 1125 ° C) to the level of vitrifying the clay.

Megalithic Pottery of Tamil Nadu

Containers of various sizes and shapes, burial urns, sarcophagus and figures of animals are four important types of terracotta collected from the South Indian megalithic sites. Both the burial urns and sarcophagus were made to intern the remains of the dead along with the small pots containing things of utility, meant for the dead in the next world. Again the small size potteries display varieties like blackware, red and blackware and burnished ware.

The Neolithic and Megalithic potteries of Tamil Nadu exhibit five major types. They are red ware, tanware, greyware, brownware and blackware with their variants. However, plain pottery dominates the ceramic industry. The pottery with incised and combed decoration has been obtained at some places. Most of the potteries were handmade and show granular texture in the core. These pottery articles vary greatly as to shape, some being flat and broad, others more or less globular and some pear shaped. In some cases, the amphora like pear shaped vessels has feet. Some of the small cup like vessels from the megalithic burial sites are covered on the inner side with a black lacquer like varnish. The most common mode of producing a simple black colour is to fire the vessels slowly in closed places to produce much smoke, which permeated into the clay and impregnated it.

Catalogue of Exhibits

- | | |
|--|---|
| 29) Name of the exhibit : Burial Pottery
Acc.No. : PH 29/2003
Provenance : Malabar, South India | 37) Name of the exhibit : Burial Pottery
Acc.No. : PH 37/2003
Provenance : Pudukkottai District, Tamil Nadu |
| 30) Name of the exhibit : Coloured Pottery
Acc.No. : PH 30/2003
Provenance : Coimbatore District, Tamil Nadu | 38) Name of the exhibit : Burial Pottery
Acc.No. : PH 38/2003
Provenance : Pudukkottai District, Tamil Nadu |
| 31) Name of the exhibit : Burial Pottery
Acc.No. : PH 31/2003
Provenance : Pudukkottai District, Tamil Nadu | 39) Name of the exhibit : Burial Pottery
Acc.No. : PH 39/2003
Provenance : Coimbatore District, Tamil Nadu |
| 32) Name of the exhibit : Burial Pottery
Acc.No. : PH 32/2003
Provenance : Madurai District, Tamil Nadu | 40) Name of the exhibit : Burial Pottery
Acc.No. : PH 40/2003
Provenance : Coimbatore District, Tamil Nadu |
| 33) Name of the exhibit : Burial Pottery
Acc.No. : PH 33/2003
Provenance : Vellore District, Tamil Nadu | 41) Name of the exhibit: Burial Pottery
Acc.No. : PH 41/2003
Provenance : <i>Udhagamandalam</i> ,
Nilgris District, Tamil Nadu |
| 34) Name of the exhibit : Burial Pottery
Acc.No. : PH 34/2003
Provenance : Vellore District, Tamil Nadu | 42) Name of the exhibit : Base of Burial Pottery
Acc.No. : PH 42/2003
Provenance : Malabar, South India |
| 35) Name of the exhibit : Burial Pottery
Acc.No. : PH 35/2003
Provenance : Madurai District, Tamil Nadu | |
| 36) Name of the exhibit : Burial Pottery
Acc.No. : PH 36/2003
Provenance : Madurai District, Tamil Nadu | |

Terracotta

The earliest terracottas in Tamil Nadu are in the form of human and animal figures from *Paiyampalli*, Tirupattur Taluk of Vellore District, dating to the neolithic period between 3000 and 1000 BC (Narasimaiah, B., 1983). The figures are crude and represent terracotta art in its infancy.

The megalithic sites in the Nilgiri hills yielded a number of terracottas in the form of human and animal figures, both religious and secular. These are hand-moulded either completely or partially and have incised dot impressions on the body. Several parts are made separately and then joined together. Their linear composition renders them static, the only dynamism conveyed is by the movement of the hands. Moulded figures were unknown in the early period.

Between about the third century BC and the fourth century AD, sites such as *Arikamedu* (Pondicherry), *Kancheepuram*, *Tirukkampuliyur*, *Alagarai* in South Arcot district (present Cuddalore district), *Uraiyur* near Trichy and *Kaveripoompattinam* (Poompuhar, Nagapattinam District) produced large quantities of terracotta objects. The figures, religious as well as secular include village deities, *vriksha devatas* (spirits of the trees), *nagalingas* (serpent *siva lingas*), *vaishnavite* and *saivite* deities and their symbols, Buddhist and Jain symbols and figures (especially in *Kaveripoompattinam*) of women in royal headgear, dancers, men and women, including aborigines, in various poses, head-dresses, garments and ornaments and, finally, terracotta jewellery and musical instruments. The ornamentation on the clay included a myriad of painted designs and incised and appliquéd patterns.

The art of terracotta making continues at the same two levels till today. The first is for every-day use in the villages and extends to the making of mud huts and kitchens and the second level is the figures of gods, goddesses, their attendants, votive objects and the most important ones, the horses.

Nowadays making a terracotta figure involves several days of work for the village potter, who is helped in his work by his family members. The moist clay is mixed with straw and sand to achieve the proper consistency. In the case of a horse, it is rolled into four cylinders with a piece of wood. The four cylinders are joined to become the legs and the body is built up gradually, with rolls of clay, up to the neck. The trimmings, consisting of bells, mirrors, grotesque faces (*kirtimukha* - literally faces of glory) and sometimes *makaras* (crocodiles) are made separately and joined to the main figure. The belief is that the bells are supposed to warn miscreants of *Ayyanaar's* arrival.

While the *kirtimukhas* and *makaras* frighten them off. The horse's head is made separately and supported by pots and sticks to prevent sagging while it dries. All the parts are joined together after they dry and on the auspicious tenth day, the image of *Ayyanaar*, seated on the horse, is given its features, to create the character. The whole is baked in a rustic kiln of unfired pots placed around the figure, fuelled by a combination of straw and *varatti* (dried cow-dung with straw) and covered with mud. In the case of large figures, the various parts of the body are made separately and fired. They are then joined together and fired again. Sometimes the figures are painted. The faces are painted red, denoting anger, and the neck blue denoting calmness. The rest of the body and decorations are also painted in vivid colours.

While the earlier *Ayyanaars* were made along simple lines, the later ones are identified by larger eyeballs and with more ferocious eye brows. As time passed, the eyebrows became straight and there was an increase of straight and angular lines. Later still, the moustache increased in size and the figures were brightly painted. The oldest *Ayyanaars* and horses are probably to be found in Salem district.

Today, Salem and Pudukkottai districts are the sites of the manufacture of the large terracotta horses, although the smaller figures-human, divine and animals-are made all over the state. While in the past all terracotta were individually made and fired, the increasing demand in the market, particularly for terracotta art items has resulted in the development and use of moulds.

Sometimes *Ayyanaar*'s horses and commanders are made of stucco. While stucco art faithfully copies the terracotta forms, it is unable to reproduce the grace and beauty of the terracota and the stucco figures look stiff and lifeless.

Catalogue of Exhibits

- | | |
|---|--|
| <p>43) Name of the exhibit : Buffalo Figure
 Acc.No. : TC 1/2003
 Provenance : <i>Udhagamandalam</i>, Nilgris District,
 Tamil Nadu
 Age : About 3000 years</p> | <p>Nilgris District, Tamil Nadu
 Age : About 3000 years</p> |
| <p>44) Name of the exhibit : Dog Figure
 Acc.No. : TC 2/2003
 Provenance : <i>Udhagamandalam</i>,</p> | <p>45) Name of the exhibit : Peacock
 Acc.No. : TC 3/2003
 Provenance : <i>Udhagamandalam</i>, Nilgris District,
 Tamil Nadu
 Age : About 3000 years</p> |

46) Name of the exhibit : Buffalo

Acc.No. : TC 4/2003

Provenance : *Udhagamandalam*, Nilgris District,
Tamil Nadu

Age : About 3000 years

48) Name of the exhibit : *Ganesha*

Acc.No. : TC 6/2003

Provenance : Cuddalore District, Tamil Nadu

Age : Late 20th century AD

47) Name of the exhibit : Horse

Acc.No. : TC 5/2003

Provenance : Cuddalore District, Tamil Nadu

Age : Late 20th century AD

Glazed Pottery

In course of time, along with technical development people wanted to improve the appearance of their potteries or terracotta objects with a smooth and glossy surface. They also felt the need to make the surface of their potteries impervious to liquids, water etc. Glazing provided these facilities. Glazing is a process of applying glaze which is a fine powder, consisting of a mixture of glass-making materials (lead silicates, borosilicate etc) in proper composition. The glazing mixture, free from iron and other colouring pigments is used for colourless glaze. For colour glazing, coloured metal oxides or pigments are mixed in proper proportions. Iron oxide is used for red and brown colours. Iron oxide and lime are used for cream and yellowish tints. Green and blue colours are obtained by using copper oxide and cobalt blue respectively.

Glazing is done either by salt glazing or by liquid glazing. In salt glazing common salt (sodium chloride) is used for getting "Glassy-films" over the earthenware. In this method common salt is thrown in to the furnace, while the articles are in red-hot condition. Intensive heat volatilises the salt and it reacts with silica of the articles to form a glassy and impervious film of Sodium Silicate.

Liquid glazing is a better method. In this method, a fine powder of glaze mixture and requisite quantity of colour pigments are mixed with water to form a solution called as glaze-slip. The objects to be glazed are first burnt at a low temperature in a kiln. They are then taken out and dipped in the glaze slip. The glaze materials enter and fills the pores in the objects. Then the

objects are fired again at a higher temperature so that the glaze material fuses and forms thin glassy films over them. During firing every care is taken to see that objects do not come in direct contact with fire, so as to avoid dirt and soot that may discolour them.

Karigiri Pottery

The art of making glazed pottery seems to have come to India from China by way of Persia. According to T.N. Mukharji (1888), the notable places where artistic potteries of this kind were made in Tamil Nadu during 19th century AD were Madras, Madurai and Salem. The glazed potteries from the village *Karigiri*, Gudiyattam Taluk, North Arcot district are imitations of Delhi wares. Under the patronage of the Arcot Nawabs, this art of Karigiri pottery developed in this village. Karigiri pottery often has a marbled or shaded appearance. The colour of this glaze is of different shades of green. The ornamentation is entirely surface decoration, carried out in the plastic clay before the glaze is put on and consists of various floral and other patterns.

Great care was taken in preparing the clay for making this pottery. As described by Cox in his North Arcot Manual, after being fashioned on the wheel, the pottery was dried for ten days in the shade and two days in the sun. Then it was baked for twelve hours in a closed oven. To produce the glaze, equal parts of verdigris (*Vengala Pachai*) and bangle earth (*Savadu Mann*, an alkaline earth) were fused in a furnace till they formed a green glaze. This was powdered and mixed with water and painted over the pottery. Then the pottery was dried in the sun and baked as before. If half a part of white lead is added to the verdigris and bangle earth a yellow glaze is produced. If the baking is prolonged, the glaze assumes blackish colour. In the early nineteenth century, Karigiri type glazed potteries were made in other places like *Sivagangai*, *Madurai*, *Tirumangalam*, *Periyakulam*, *Gudiyattam*, *Salem*, *Trichy* and *Thanjavur*.

Catalogue of Exhibits

- | | |
|---|--|
| 49) Name of the exhibit : Magic Jug (Brown colour with floral design) | 50) Name of the exhibit : Jar (Green colour with floral design) |
| Acc.No. : Ka 1/2003 | Acc.No. : Ka 2/2003 |
| Provenance : <i>Karigiri</i> Village, Vellore District, Tamil Nadu | Provenance : <i>Karigiri</i> Village, Vellore District, Tamil Nadu |

51) Name of the exhibit : Magic Krishna (Green Pottery depicting Krishna sitting on the bowl)

Acc.No. : Ka 3/2003

Provenance : *Karigiri* Village, Vellore District, Tamil Nadu

53) Name of the exhibit : Flower Vase (Green colour with four cranes)

Acc.No. : Ka 5/2003

Provenance : *Karigiri* Village, Vellore District, Tamil Nadu

52) Name of the exhibit : Pot (Brown colour with floral design)

Acc.No. : Ka 4/2003

Provenance : *Karigiri* Village, Vellore District, Tamil Nadu

Ceramics

Ceramics are inorganic, non-metallic materials that are processed and/or used at high temperatures. In the case of advanced Ceramics, they include silicates, metallic oxides and their combinations. Ceramics can be classified into three broad divisions.

1. Clay products
2. Refractories
3. Glasses.

Natural rocks and their disintegrated products like clay, sand and gravel are closely related to ceramics in chemical composition. In the modern context, the word ceramic (any product that is first shaped and then hardened by means of heat) has a wider meaning. In the olden days, it referred mostly to objects made from Potter's Clay. But now it refers to a large range of modern materials of quite a different composition. Authorities differ considerably in their technical classification of pottery. In its simplest classification it may be grouped broadly into two groups - non-vitreous and vitreous pottery.

Non-vitreous or soft pottery is commonly called earthenware. The simplest type of earthenware may be seen in the unglazed pottery and terracotta common to all primitive societies. Primitive and historic pottery used the clay, which was more readily available. Such ordinary field and surface clays have various amount of iron and other impurities and when fired above a red hot temperature tend to become buff to dark brown in colour.

Stoneware is the oldest type of vitreous ware, made of coarse, sandy and heat resistant clay stoneware becomes hard, dense, non-absorbent, opaque and light grey to brown in colour. The toughness and acid resisting qualities of stoneware makes it a valuable material for the manufacture of industrial chemical containers and for drainage pipes.

Catalogue of Exhibits

- | | |
|--|--|
| 54) Name of the exhibit : Ash Tray (Lion faced)
Acc. No. : Ce 1/2003
Provenance : <i>Virudhachalam</i> , Cuddalore District,
Tamil Nadu | 60) Name of the exhibit: Nandhi (Bull)
Acc. No. : Ce 7/2003
Provenance : <i>Virudhachalam</i> , Cuddalore District,
Tamil Nadu |
| 55) Name of the exhibit : Head of a Woman
Acc. No. : Ce 2/2003
Provenance : <i>Virudhachalam</i> , Cuddalore District,
Tamil Nadu | 61) Name of the exhibit: Bust of a Village Deity
Acc. No. : Ce 8/2003
Provenance : <i>Virudhachalam</i> , Cuddalore District,
Tamil Nadu |
| 56) Name of the exhibit : Model of a House
Acc. No. : Ce 3/2003
Provenance : <i>Virudhachalam</i> , Cuddalore District,
Tamil Nadu | 62) Name of the exhibit: <i>Nandhi</i> (Bull)
Acc. No. : Ce 9/2003
Provenance : <i>Virudhachalam</i> , Cuddalore District,
Tamil Nadu |
| 57) Name of the exhibit : Tea Cup
Acc. No. : Ce 4/2003
Provenance : <i>Virudhachalam</i> , Cuddalore District,
Tamil Nadu | 63) Name of the exhibit: <i>Madurai Veeran</i> (Village deity)
Acc. No. : Ce 10/2003
Provenance : <i>Virudhachalam</i> , Cuddalore District,
Tamil Nadu |
| 58) Name of the exhibit: Bowl with Lid
Acc. No. : Ce 5/2003
Provenance : <i>Virudhachalam</i> , Cuddalore District,
Tamil Nadu | 64) Name of the exhibit: Horse
Acc. No. : Ce 11/2003
Provenance : <i>Virudhachalam</i> , Cuddalore District,
Tamil Nadu |
| 59) Name of the exhibit: Container
Acc. No.: Ce 6/2003
Provenance : <i>Virudhachalam</i> , Cuddalore District,
Tamil Nadu | 65) Name of the exhibit: Horse
Acc. No. : Ce 12/2003
Provenance : <i>Virudhachalam</i> , Cuddalore District,
Tamil Nadu |

Parrywares

At the closing years of the 19th century AD, EID Parry's came to Ranipet to run a bone-mill for producing fertilisers. Bones were good but phosphates were better preferred. Phosphates treated with sulphuric acid react to form super phosphates and therefore better still. But sulphuric acid is corrosive to handle and transport. So EID set up a plant at Ranipet to produce sulphuric acid. In this way, the bone mill led to the manufacture of sulphuric acid and chemicals (Hilton Brown, 1954). The sulphuric acid coupled with magnesite from Salem, furnished a useful sideline in Epsom salts usable in tanneries. In the production of sulphuric acid a difficulty arose in regard to jars for storing sulphuric acid. To overcome this difficulty in 1908, Ranipet Pottery Industry was started. From plain jars for sulphuric acid, the pottery moved to bright jars and sanitary wares. Then came cups and saucers, vases and ornaments including little moulded figures. The biscuit colour brown rimmed jars was a favourite of the middle class people of Tamil Nadu in the first half of the 20th century AD. They used these jars for stocking pickle. Selected few pickle jars donated by the former Director of Museums, Thiru N. Harinarayana has been displayed in the gallery.

Catalogue of Exhibits

- | | |
|---|---|
| 66) Name of the exhibit : Pickle Jar
Acc. No. : PW 1/2003
Provenance : <i>Ranipet</i> , Cuddalore District,
Tamil Nadu | 70) Name of the exhibit : Pickle Jar
Acc. No. : PW 5/2003
Provenance : <i>Ranipet</i> , Cuddalore District,
Tamil Nadu |
| 67) Name of the exhibit : Pickle Jar
Acc. No. : PW 2/2003
Provenance : <i>Ranipet</i> , Cuddalore District,
Tamil Nadu | 71) Name of the exhibit : Water Closet (miniature
model, light blue colour)
Acc. No. : PW 6/2003
Provenance : <i>Ranipet</i> , Cuddalore District,
Tamil Nadu |
| 68) Name of the exhibit : Pickle Jar
Acc. No. : PW 3/2003
Provenance : <i>Ranipet</i> , Cuddalore District,
Tamil Nadu | 72) Name of the exhibit : Water Closet
(miniature model, navy blue colour)
Acc. No. : PW 7/2003
Provenance : <i>Ranipet</i> , Cuddalore District,
Tamil Nadu |
| 69) Name of the exhibit : Pickle Jar
Acc. No. : PW 4/2003
Provenance : <i>Ranipet</i> , Cuddalore District,
Tamil Nadu | |



A



B



C

Pottery and Glazed Pottery

A. Sl. No. 29 - 32

B. Sl. No. 43, 48, 47

C. Sl. No. 49 - 51



A



B



C

Glazed Pottery, Ceramics, Parryware, Advanced Ceramics

A. Sl. No. 53, 63, 64

B. Sl. No. 67, 71 - 73

C. Sl. No. 66, 84

- 73) Name of the exhibit : Water Closet (miniature model, light rose colour)
Acc. No. : PW 8/2003
Provenance : *Ranipet*, Cuddalore District, Tamil Nadu
- 74) Name of the exhibit :Water Closet (miniature model, Black colour)
Acc. No. : PW 9/2003
Provenance : *Ranipet*, Cuddalore District, Tamil Nadu
- 75) Name of the exhibit : Water Closet (miniature model, White colour)
Acc. No. : PW 10/2003
Provenance : *Ranipet*, Cuddalore District, Tamil Nadu
- 76) Name of the exhibit: Water Closet
Acc. No. : PW 11/2003
Provenance : *Ranipet*, Cuddalore District, Tamil Nadu
- 77) Name of the exhibit: Water Closet
Acc. No. : PW 12/2003
Provenance : *Ranipet*, Cuddalore District, Tamil Nadu
- 78) Name of the exhibit: Wash Basin (miniature model, Black colour)
Acc. No. : PW 13/2003
Provenance : *Ranipet*, Cuddalore District, Tamil Nadu
- 79) Name of the exhibit : Wash Basin (miniature model, White colour)
Acc. No. : PW 14/2003
Provenance : *Ranipet*, Cuddalore District, Tamil Nadu
- 80) Name of the exhibit : Wash Basin
Acc. No. : PW 15/2003
Provenance : *Ranipet*, Cuddalore District, Tamil Nadu
- 81) Name of the exhibit : Wash Basin
Acc. No. : PW 16/2003
Provenance : *Ranipet*, Cuddalore District, Tamil Nadu
- 82) Name of the exhibit : Wash Basin (Floral shape)
Acc. No. : PW 17/2003
Provenance : *Ranipet*, Cuddalore District, Tamil Nadu
- 83) Name of the exhibit : Water Tank with Lid (water dispenser to the closet)
Acc. No. : PW 18/2003
Provenance : *Ranipet*, Cuddalore District, Tamil Nadu

Advanced Ceramics

The critical demands of many industries of the 20th Century AD gave impetus for the development of advanced ceramics. In aerospace industry objects in proper weight strength ratios and thermal shock resisting dielectric, abrasive and refractory properties are critical. The application of ceramic materials in the aerospace industry include the use of alumina ceramics for missiles and rocket nose cones. Silicon carbide or Molybdenum is used in rocket nozzles. Ceramic coatings are used on metal parts of rockets and satellites and ceramic materials are used for thermal insulation in spacecraft.

The discoveries of refractory ceramics, magnetic ceramics and non-linear dielectric ceramics revolutionised our industries both in metallurgy and spacecraft. Refractory ceramics are used in the Oxygen-Processing method of steel making. This type of process required new or improved refractory materials to keep the steel under severe conditions. The development of direct bonded and fused cast type of chrome magnesite, high purity magnesia and tar bonded dolomites have helped the utilisation of existing furnaces and permitted higher temperature and more severe oxidation and reduction conditions than were possible with the old refractories. Magnetic ceramics are ferrites (iron oxide compounds). They are complex multiple oxides of iron oxide. The magnetic properties of these compounds vary, depending on the metallic oxide that is combined with the iron oxide. Barium ferrites, strontium ferrites and lead ferrites are permanent type ceramic magnets and are usable in small direct current motors for automobiles. Manganese ferrites and Nickel-zinc ferrites in combination with other compounds are used in computer memory cores and telecommunication systems. Non-linear dielectric ceramics like lead zirconate - titanate, lead niobates, barium titanate and other combinations of titanates are electrical insulating materials. They play a vital role in the miniaturization of electronic parts and in the development of sophisticated electrical circuitry.

Catalogue of Exhibits

84) Name of the exhibit : Mould Shell (made of advanced ceramic for the purpose of investment casting)

Acc. No. : AC 1/2003

Provenance : Hyderabad, Andhrapradesh

STONE CRAFT - ROCK CUT ARCHITECTURE

The stone craft initiated in the Palaeolithic period progressed well with the development of human civilisation. In Tamil Nadu for the first time, we find stone craft as a matured art of architecture and sculpture in the 7th century AD monolithic temples of *Mahabalipuram*. The burst of artistic energy under the famous Pallava rulers like *Mahendravarman I* (590-630 AD), *Narasimhavarman I* (630-668 AD) and *Rajasimhan* (690-729 AD) is well epitomised in the caves, monolithic and sculpted panels of this stone city. Of the nine free standing monolithic buildings scattered through out *Mahabalipuram*, a group of five near the sea is unique for its theme and execution. These are the earliest surviving examples of rock cut structure, complete both inside and outside. These monoliths are called as *Pancha Pandava Rathas*. Of the five, one is assigned to the younger brothers, *Nakula* and *Sahadeva*; another one to *Draupadi*, the consort of the five brothers; the other three Rathas are for *Arjuna*, *Bhima* and *Dharmaraja* respectively.

From the unfinished examples of the rock cut temples at *Mahabalipuram*, we may presume that the artisans proceeded with their work from the top to bottom, completing each section as they worked and using the uncut rock beneath as a platform up on which to work. The five monolithic *Rathas* are important not only in their own right but as documents of the freestanding temple architecture of the Pallavas. They also provide vital information regarding the genesis of South Indian architectural forms.



The smallest and simplest of the five *Rathas* is the *Draupadi Ratha*. It is a shrine dedicated to *Durga*. It has been modelled after a thatched hut with curved roof. Square in plan, this single celled one story temple shares a low plinth with the adjacent *Arjuna Ratha*. The exterior pith (wall) decoration are the pilasters at each of the four corners and niches with images. The two niches on either side of the entrance door contain life size female door guardians holding a bow in their right arms. The single niches on the other three sides, each contain a representation of the Goddess *Durga*. The rear wall of the interior sanctum bears a panel depicting *Durga* in standing pose being adored by devotees. One of them is shown as performing self-decapitation.

The *Arjuna Ratha* is different in appearance. The pillared facade of this square shrine is reminiscent of the format of cave architecture. The superstructure clearly reflects the form of a structural building. The two-tiered roof is pyramidal in shape and is mounted by a domelike octagonal *Shikhara*. Each of the levels of the roof is decorated with miniature barrel vaulted roofs (Slab) interspersed with *chandrasalas* (a rounded arch of the type formed by the end of the *Sala*) and pilastered niches. The two side walls have six niches and the rear wall has five niches. Male attendants are sculpted at the corners of each wall while the central niches have the figures of deities, *Vishnu* on the north wall, *Siva* leaning on *Nandhi* on the South wall and an elephant rider on the east wall. Scholars differ while identifying him. *Indra*, *Murugan* and *Aiyanar* are associated with the elephant. All the three have the elephant as their mount and this led scholars to identify the figure differently.

Bhima's Ratha is a two storied, oblong structure with a barrel-vaulted roof. Though the main image is not carved, the elongated space of the structure makes us to surmise *Vishnu* as *Anantasayana* in reclining posture as the intended main image of this shrine. As in the case of *Arjuna Ratha*, *Chandrasalas* and miniature barrel vaulted shrines decorate the upper levels of the *Ratha*. The pillared facade with seated lion bases illustrate one of the Pallava architectural formats.

The unfinished *Dharamaraja Ratha* is the tallest of the group. In design it is similar to *Arjuna Ratha*. But it is larger and more elaborate. This monolithic free standing shrine demonstrates the fully developed southern style of architecture. The South Indian style superstructure has three stories that diminish in size as they ascend forming a pyramidal profile. Each roof is decorated with *Salas* and *Chandrasalas* and the whole is capped by an octagonal *Shikhara*. The form of

this shrine was the basis for subsequent South Indian temples of Chola, Vijayanagara and Nayak periods.

The last of the group, the *Nakula-Sahadeva Ratha* is not in line with the other four. The shrine faces south. The form of this shrine is extremely important to study the development of South Indian architecture. The apsidal shape of this temple is a rare type among the surviving Hindu temples. The temple is capped by Sala roof. Through the exterior rear of the shrine is rounded the interior sanctum is square. The five monolithic *panchapandava ratha* have been illustrated in the gallery through vinyl print cut outs.

IRRIGATION

An overview

As soon as man settled down to an agrarian way of life and started cultivation of crops, they needed assured water supply. Damming rivers started. *Karikala Chola* built probably the earliest water storage for irrigation. This was called the Grand Anicut, spanning the Cauvery River and the Coleroon River near Thanjavur. From this grand scale to the one man operated Picottah the range of ancient irrigation devices was wide. In the modern era, this has become diesel and electricity powered pump sets. The pump sets, photographs and models are displayed in the gallery.

An elaboration

The Grand Anicut is built across river Cauvery, 16 km east of Tiruchirapalli Town. It is a marvellous piece of hydraulic structure built across a mighty river in its sandy bed when the science had not developed to build safe structures on permeable foundation. It serves to this day excellently with a few modifications made in the nature of improvements to the structure (Mohanakrishnan.A., 2001) Next to Karikala's Grand Anicut, the Mettur Stanley Reservoir is the biggest Irrigation Project of the State. It is the first storage reservoir across river Cauvery in Tamil Nadu. It was built at Mettur between the years 1928-1934 with a capacity of 2,645 Mm³ (93,470 Mcft). The second author's grandfather was one of the engineers who built this dam.

The Pykara Hydro Electric Scheme in Nilgris completed in 1935 and the Papanasam Hydro Electric Project taken up in 1938 are the pioneering efforts made by the British Government to install Hydro Power Stations in Bhavani and Tamaravaruni rivers.

Due to the failure of monsoons, in recent years the use of bore wells has increased enormously. Coimbatore has become a centre of producing pump sets and rigging equipments. Now-a-days

diesel/kerosene/petrol pump sets of small size and high lifting capacity are produced. In the gallery, pump sets with their component parts are displayed.

Catalogue of Exhibits

- 85) Name of the exhibit : Ventura – Mono block Pump set - 0.125 HP
Acc. No. : Ir 1/2003
Provenance : Coimbatore District, Tamil Nadu
- 86) Name of the exhibit : Villiers – Power Driven Pumpset – 1.1 KW with 11 components
Acc. No. : Ir 2/2003
Provenance : Guindy, Chennai, Tamil Nadu

METALS

An overview

The third theme of this exposition is metal working. In North India, the Metallurgy era started with copper and then went on to brass, bronze, iron and finally steel in the historic era. In Tamil Nadu, the sequence was not the same. The Damascus steel that was used to make sword blades in Europe was supposed to have gone from India till the mediaeval era.

The Gupta era pillar near the Kutub Minar in Delhi stands as a testimony to the excellence of Indians in Metallurgy. It has still not rusted though it was cast around the 5th century AD. But we lost our technological lead somewhere and had to rely on steel making from the European countries. This process of making steel was invented by Abraham Darby in Iron Bridge Gorge in England in the 17th Century AD. It was brought to India by Jamshedji Tata. Coal as a fossil fuel in preference to charcoal came to be used in iron smelting. In Tamil Nadu, from the 1950s, Lignite a form of coal with lower calorific value came to be mined and used for power generation and other uses. In the showcases, iron and steel making is dealt with by way of photographs and models. Magnesite ores are required for making refractory bricks without which iron and steel cannot be smelted. We show the process of steel making with reference to the special steels- stainless steel. An elaboration on the important industries of the 19th and the first half of the 20th Century AD. and the ancillary industries are presented in the chapters on Industries of Tamilnadu. (Refer page nos: 91 - Refractories, 94 - Iron and Steel, 109 - Fossil Fuels). We have exhibits from the Salem Steel Plant. We show how the iron and steel industry developed into castings from Coimbatore and other products like pump sets in which Tamil Nadu is a leader. Titanium, the latest metal, has been presented as a plate.

An elaboration

Art Metalware

The artistic metalware of Tamil Nadu includes wax-moulded icons and box-moulded *kuthuvilakkus* (lamps), silver and copper encrusted brass sheet work, and bronze sculpture. The production of bronze and copper icons by the *cire perdue* (lost wax) process is concentrated mainly in the *Swamimalai* area of Thanjavur, though the craft exists also in *Kumbakonam*, *Nachiarkoil*, *Tambaram*, *Madurai* and a few other places. Craftsmen usually manufacture the icons on the orders from temples. Sometimes the order specifies particulars of design but very often these are left to the craftsman's discretion. Copies of old masterpieces are also being cast for sale, under the direct supervision of traditional master craftsmen.

Catalogue of exhibits

- | | |
|--|---|
| 87) Name of the exhibit : Betel nut box in the form of tortoise
Acc.No. : MW 1/2003
Provenance : Tamil Nadu
Age : Circa 19 th century AD | 91) Name of the exhibit : Peacock
Acc. No. : MW 5/2003
Provenance : Tamil Nadu
Age : Circa 19 th century AD |
| 88) Name of the exhibit : Scorpion
Acc. No. : MW 2/2003
Provenance : Tamil Nadu
Age : Circa 19 th century AD | 92) Name of the exhibit : Betel nut box in the form of fish (Big)
Acc. No. : MW 6/2003
Provenance : Tamil Nadu
Age : Circa 19 th century AD |
| 89) Name of the exhibit : Deer
Acc. No. : MW 3/2003
Provenance : Tamil Nadu
Age : Circa 19 th century AD | 93) Name of the exhibit : Betel nut box in the form of fish (Small)
Acc. No. : MW 7/2003
Provenance : Tamil Nadu
Age : Circa 19 th century AD |
| 90) Name of the exhibit : Garden Lizard
Acc. No. : MW 4/2003
Provenance : Tamil Nadu
Age : Circa 19 th century AD | 94) Name of the exhibit : Cock
Acc. No. : MW 8/2003
Provenance : Tamil Nadu
Age : Circa 19 th century AD |

95) Name of the exhibit : Bird
Acc. No. : MW 9/2003
Provenance : Tamil Nadu
Age : Circa 19th century AD

96) Name of the exhibit : Parrot
Acc. No. : MW 10/2003
Provenance : Tamil Nadu
Age : Circa 19th century AD

97) Name of the exhibit : Parrot
Acc. No. : MW 11/2003
Provenance : Tamil Nadu
Age : Circa 19th century AD

98) Name of the exhibit : Container (in bull form)
Acc. No. : MW 12/2003
Provenance : Tamil Nadu
Age : Circa 19th century AD

99) Name of the exhibit : Decorative Elephant
Acc. No. : MW 13/2003
Provenance : Tamil Nadu
Age : Circa 19th century AD

100) Name of the exhibit : Yali Face (mythological animal or may be extinct having the face of a lion and the trunk of an elephant)
Acc. No. : MW 14/2003
Provenance : Tamil Nadu
Age : Circa 19th century AD

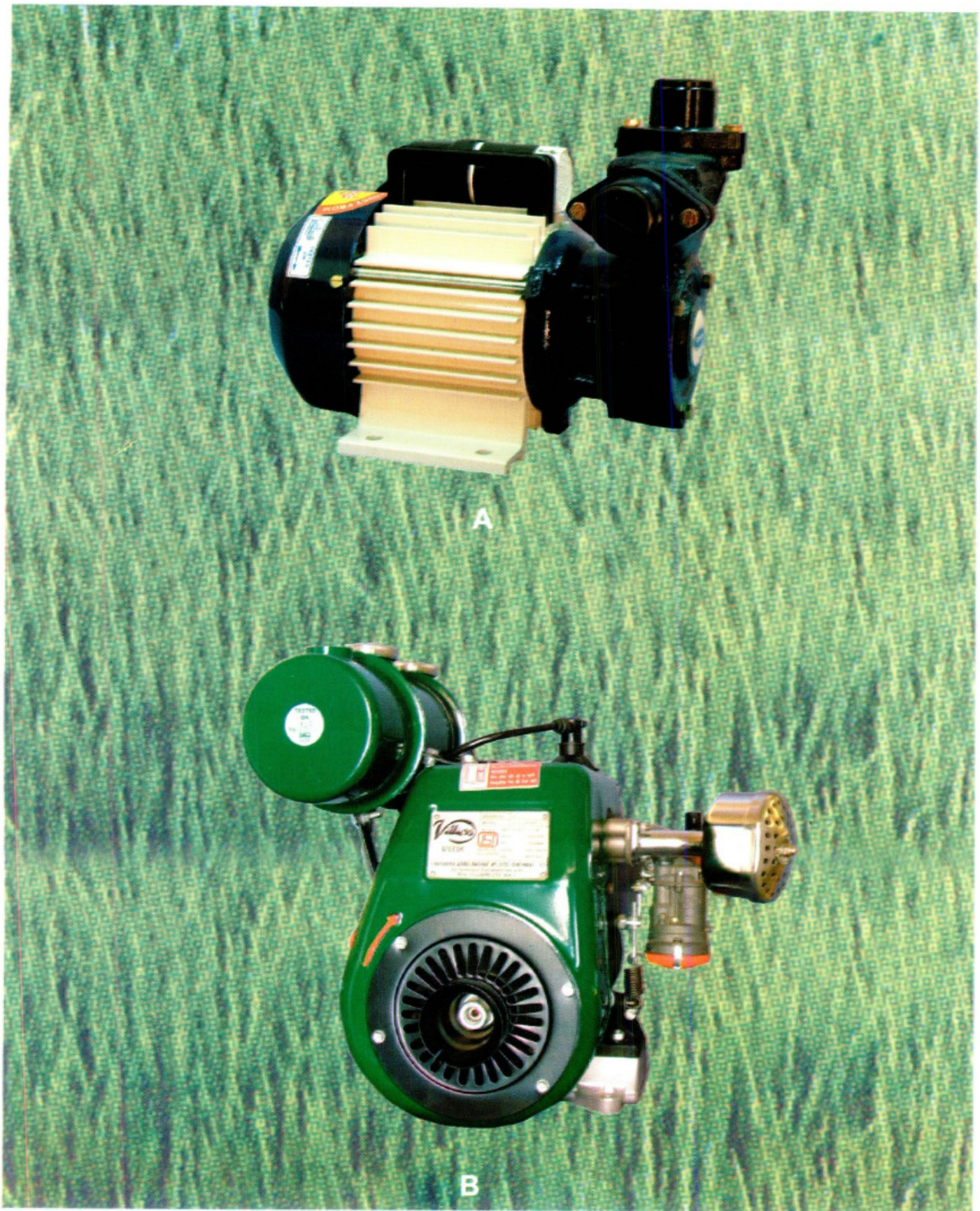
101) Name of the exhibit: Water Boiler (copper)
Acc. No. : MW 15/2003
Provenance : Tamil Nadu
Age : Circa 19th century AD

Bronze Icons

The science of metallurgy reached its zenith in Tamil Nadu during the time of Tanjore Chola's (circa 9th century - 13th century AD). Even today, the world gazes with awe at the beautiful Chola bronze icons cast during this period. They used what is called the Lost wax process in English - *madhuchista vidhana* in Sanskrit and *Cire perdue* in French and கரைமெழுகு வார்ப்பு in Tamil. Using this process, it is possible to cast only one bronze from one clay mould.

This ancient craft is very much alive and vibrant in Tamil Nadu even today in *Swamimalai* near Kumbakonam in Thanjavur district. This place specialises in producing solid cast bronze icons. *Nachiarkoil* near Kumbakonam specialises in casting lamps using wax moulds. These lamps are hollow cast. They use appropriate modern machinery. The moulds cast in metal are capable of re-use many times.

We see here the methods adopted by Poompuhar, a Tamil Nadu government undertaking, for casting bronze icons in Swamimalai and lamps at Nachiarkoil at their production centre.



Pump Sets

A. SI. No. 85

B. SI. No. 86



A



B

Metal Work

A. Sl. No. 88- 91

B. Sl. No. 92

Traditional Bronze Casting

In the traditional process of Lost Wax casting the icon desired to be cast has to be made in special wax as an image. *Kungiliyam* (dammer) and bee-wax in equal weight are taken and heated in groundnut oil to create this special wax mixture. This is made into the wax image. The torso, hands, and feet are made separately and joined together to create the image. On this wax image a layer of fine alluvial river sand is coated. On this layer, several layers of clay mixture coat are



applied to the extent necessary for proper production of the image. This creates a clay mould on the wax image i.e. called a negative mould. Holes are made to pour in the molten metal alloy mixture and to draw out the molten wax from the clay mould created on the wax image. The wax image coated with clay is called an 'embryo' in this art form. The Embryo is created with care. This is to ensure that as soon as the molten metal is poured in the wax mould melts, the wax pours out without creating distortion on the negative clay mould image and also air bubbles do not form. This ensures even melting of the wax image as soon as the molten alloy is poured in. The wax comes out at this juncture. The molten alloy is cast in this state. After the clay with metal cools and solidifies the layers are broken to reveal the metal cast image inside. The protuberances are chipped and removed and the finishing touches including the opening of the eyes and shaping of features is done. The traditional artisan who does this is called a '*stapathi*'. It is his ingenious skill that gives the individual masterly touch and finish to each image and makes it a piece of fine art.

The wax and the clay - sand mixture layer coated on top of the wax images should be of the highest quality. This alone can ensure that the fine tolerances that is expected from the 'Lost Wax' method will be realised. They should also be able to withstand heat that is generated during this process.

Catalogue of exhibits

- | | |
|--|---|
| <p>102) Name of the exhibit : Honey Wax
Acc. No. : BI 1/2003
Provenance : Tamil Nadu</p> | <p>109) Name of the exhibit : Wax Model (for casting the figure)
Acc. No. : BI 8/2003
Material : Special hard wax
Provenance : Tamil Nadu</p> |
| <p>103) Name of the exhibit : Hard Wax
Acc. No. : BI 2/2003
Provenance : Tamil Nadu</p> | <p>110) Name of the exhibit : Crucible (Small)
Acc. No. : BI 9/2003
Provenance : Tamil Nadu</p> |
| <p>104) Name of the exhibit : Nice Wax
Acc. No. : BI 3/2003
Provenance : Tamil Nadu</p> | <p>111) Name of the exhibit : Crucible (Big)
Acc. No. : BI 10/2003
Provenance : Tamil Nadu</p> |
| <p>105) Name of the exhibit : <i>Kungilium</i>
Acc. No. : BI 4/2003
Material : <i>Kungilium</i> (Dammer)
Provenance : Tamil Nadu</p> | <p>112) Name of the exhibit : Copper Bits
(for casting the icon)
Acc. No. : BI 11/2003
Provenance : Tamil Nadu</p> |
| <p>106) Name of the exhibit : Alluvial Soil
Acc. No. : BI 5/2003
Provenance : Tamil Nadu</p> | <p>113) Name of the exhibit : Dancing <i>Ganesa</i>
Acc. No. : BI 12/2003
Metal : Bronze
Provenance : Tamil Nadu
Age : Circa 20th century AD</p> |
| <p>107) Name of the exhibit : <i>Odi-olai</i>
(coconut leaf used as measuring tape)
Acc. No. : BI 6/2003
Provenance : Tamil Nadu</p> | <p>114) Name of the exhibit: <i>Nayak</i> Male Figure
Acc. No. : BI 13/2003
Metal : Bronze
Provenance : Tamil Nadu
Age : Circa 17th century AD</p> |
| <p>108) Name of the exhibit : <i>Karu</i> (moulding mud shell)
Acc. No. : BI 7/2003
Material : Mixture of Alluvial soil husk with supporting metal wires
Provenance : Tamil Nadu</p> | |



Metal Work

Sl. No. 94, 95, 97, 98 - 100



A



B

Bronze Icons

A. Sl. No. 113

B. Sl. No. 114, 115

115) Name of the exhibit : *Nayak* Female Figure

Acc. No. : BI 14/2003

Metal : Bronze

Provenance : Tamil Nadu

Age : Circa 17th century AD

Die casting

The traditional lamp die casting has been adapted to suit modern needs and requirements. Many private units in Tamil Nadu produce pressure die cast components of automobile and electronic equipments. A few aluminium pressure die cast components produced in M/s. S.S. Engineering Industry have been displayed in the gallery.

Catalogue of exhibits

116. Name of the exhibit : Water Pump body Indicon

Acc. No. : DC 1/2003

Metal : Aluminium

Provenance : Guindy, Chennai, Tamil Nadu

120. Name of the exhibit : Inspection Coken

Acc. No. : DC 5/2003

Metal : Aluminium

Provenance : Guindy, Chennai, Tamil Nadu

117. Name of the exhibit : Die Cast Cover

Acc. No. : DC2/2003

Metal : Aluminium

Provenance : Guindy, Chennai, Tamil Nadu

121. Name of the exhibit : Scaler Ring

Acc. No. : DC 6/2003

Metal : Aluminium

Provenance : *Guindy*, Chennai, Tamil Nadu

118. Name of the exhibit : Vacuum Pump Body

Acc. No. : DC 3/2003

Metal : Aluminium

Provenance : Guindy, Chennai, Tamil Nadu

122. Name of the exhibit : Slip Ring End

Acc. No. : DC 7/2003

Metal : Aluminium

Provenance : *Guindy*, Chennai, Tamil Nadu

119. Name of the exhibit : Fuel Pump Body

Acc. No. : DC 4/2003

Metal : Aluminium

Provenance : Guindy, Chennai, Tamil Nadu

123. Name of the exhibit : Starter Housing

Acc. No. : DC 8/2003

Metal : Aluminium

Provenance : *Guindy*, Chennai, Tamil Nadu

124. Name of the exhibit : Filter Body

Acc. No. : DC 9/2003

Metal : Aluminium

Provenance : *Guindy*, Chennai, Tamil Nadu

127. Name of the exhibit : Drive End Flange

Acc. No. : DC 12/2003

Metal : Aluminium

Provenance : *Guindy*, Chennai, Tamil Nadu

125. Name of the exhibit : Vacuum Pump Body

Acc. No. : DC 10/2003

Metal : Aluminium

Provenance : *Guindy*, Chennai, Tamil Nadu

128. Name of the exhibit : Drive Pulley

Acc. No. : DC 13/2003

Metal : Aluminium

Provenance : *Guindy*, Chennai, Tamil Nadu

126. Name of the exhibit : Starter Housing

Acc. No. : DC 11/2003

Metal : Aluminium

Provenance : *Guindy*, Chennai, Tamil Nadu

Investment Casting

This method is used in modern industry, with machinery replacing human labour and skill. This, of course, creates uniform products. The minute variation in the manual process is lost.

Investment casting is an adaptation of the 'Lost Wax' method to modern technological needs. This process is used in a factory in Cuddalore by name 'Omni Cast Precision Products (P) Ltd, (SIPCOT Industrial complex, Kudikadu)' to make several modern metal products to fine tolerances. Instead of wax, polymer resins and advanced ceramics instead of clay are used.

This technique has been used from 1980 AD onwards in the world aerospace industry. Scientists in the Defence Metallurgical Laboratory, Hyderabad, India have adopted this process too and it accommodates the needs of modern air craft and space industry where zero failure rate alone is tolerable. The Commissioner of Museums and his team of Curatorial staff visited the DMRL, Hyderabad to learn their casting methods in 2002. During their visit, the DMRL presented a memento made of titanium to Dr. R. Kannan, Ph.D., I.A.S., Commissioner of Museums on the occasion of his lecture to the Scientists on 13.12.2002. The memento also is a cast done in the modern method. The Commissioner presented the memento to the Museum and the same is displayed in the gallery.

Catalogue of exhibits

- | | |
|---|--|
| 129) Name of the exhibit : Cylinder Cuppling
Acc. No.: InC 1/2003
Provenance : <i>Kudikadu</i> , Cuddalore District,
Tamil Nadu | 133) Name of the exhibit : A plate bit
Acc. No.: InC 5/2003
Provenance : <i>Kudikadu</i> , Cuddalore District,
Tamil Nadu |
| 130) Name of the exhibit : Sprocket wheel
Acc. No.: InC 2/2003
Provenance : <i>Kudikadu</i> , Cuddalore District,
Tamil Nadu | 134) Name of the exhibit : Break Arm
Acc. No.: InC 6/2003
Provenance : Tamil Nadu |
| 131) Name of the exhibit : Impellor cut section
Acc. No.: InC 3/2003
Provenance : <i>Kudikadu</i> , Cuddalore District,
Tamil Nadu | 135) Name of the exhibit : Spray body
Acc. No.: InC 7/2003
Provenance : <i>Kudikadu</i> , Cuddalore District,
Tamil Nadu |
| 132) Name of the exhibit : Metal bush
Acc. No.: InC 4/2003
Provenance : <i>Kudikadu</i> , Cuddalore District,
Tamil Nadu | 136) Name of the exhibit : DMRL Memento
Acc. No.: InC 8/2003
Metal : Titanium
Provenance : Hyderabad, Andhra Pradesh |

Embossed Works

From *Thanjavur*, the ancient capital of the Chola dynasty, come some of the finest examples of embossed work. The beautiful *Thanjavur* (Tanjore) plates, bowls, napkin rings, powder boxes etc., made of copper and brass with motifs drawn from Hindu mythology and encrusted in silver against a finely engraved background, exemplify both superlative skill and mastery of material.

Catalogue of exhibits

- 137) Name of the exhibit : *Thanjavur* plate
Acc.No. : TP 1/2003
Metal : Copper and Silver
Provenance : *Thanjavur*
Age : 20th Century AD

Metal Works - Toys and Household Utensils

The objects cast in copper, brass, bronze and bell metal, include puja items such as different types of lamps, *Sombus*, (containers for ritual water) bowls and bells, special utensils and items such as paperweights, menu stands and ash-trays which are made at *Nachiarkoil*, *Nagercoil*, *Kancheepuram* and *Arcot*. Madurai is famous for a range of charming miniature brass insect and reptile models.

In the colonial period domestic utensils were made of bell-metal and brass in most of the towns in the Madras Presidency. Bell-metal utensils were largely made at *Salem*, *Madras*, *Madurai* and *Tanjore* were noted for their brass utensils. The articles made are chiefly *Lotas*, called *Sombus* in South India, which are plain or *chased* and often of very elegant shapes; plates, cups, and lamps. Since the introduction of kerosene oil, the manufacture of brass lamps in the old style was dying out, but it has revived due to demand as a piece of traditional art. At *Tirupattur* and *Madurai*, carvings on metal were carried on to some extent. Ordinary copper utensils for household use are made at *Salem*, *Madras*, *Madurai District* and *Tanjore*. At the same places, brass manufactures of a similar kind are largely turned out. Tin utensils, consisting principally of drinking cups, lantern frames, and boxes are made at *Salem and Tanjore*. They are, however, very crude and possess no artistic merit. Lead utensils are made at *Salem and Tanjore*. At *Bellary*, pewter utensils are made. These are highly esteemed owing to the belief that food and water kept in them have a cooling effect on the human system.

Furniture is made at *Madras*, *Salem* and *Tanjore*. The designs and the ornamentations are mostly copied from European articles, but the imitation is often very fair.

Catalogue of exhibits

138) Name of the exhibit : Elephant Chariot with Rider 139) Name of the exhibit : Chair

Acc. No. : MW 16/2003

Acc. No. : MW 17/2003

Metal : Brass

Metal : Brass

Provenance : Tamil Nadu

Provenance : Tamil Nadu

Age : Circa 19th century AD

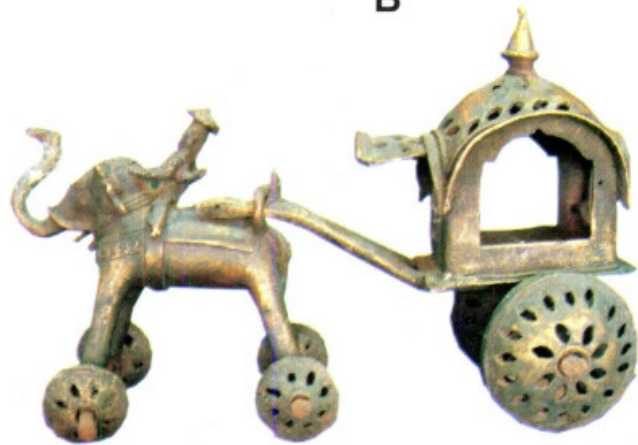
Age : Circa 19th century AD



A



B



C



D



Investment Casting and Toys

A. Sl. No. 129 - 133

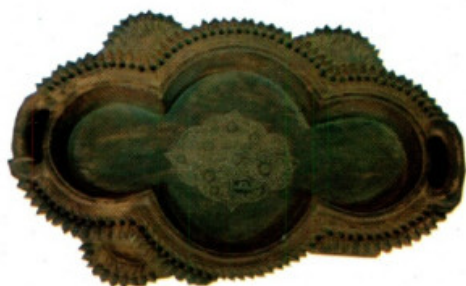
B. Sl. No. 136

C. Sl. No. 137, 138

D. Sl. No. 139, 140



A



B



Toys and Encrusted Wares

A. Sl. No. 145

B. Sl. No. 147 - 152

140) Name of the exhibit : Chair
Acc. No. : MW 18/2003
Metal : Brass
Provenance : Tamil Nadu
Age : Circa 19th century AD

141) Name of the exhibit : Chair
Acc. No. : MW 19/2003
Metal : Brass
Provenance : Tamil Nadu
Age : Circa 19th century AD

142) Name of the exhibit : Chair
Acc. No. : MW 20/2003
Metal : Brass
Provenance : Tamil Nadu
Age : Circa 19th century AD

143) Name of the exhibit : Chair
Acc. No. : MW 21/2003
Metal : Brass
Provenance : Tamil Nadu
Age : Circa 19th century AD

144) Name of the exhibit : Chair
Acc. No. : MW 22/2003
Metal : Brass
Provenance : Tamil Nadu
Age : Circa 19th century AD

145) Name of the exhibit : Cot
Acc. No. : MW 23/2003
Metal : Brass
Provenance : Tamil Nadu
Age : Circa 19th century AD

146) Name of the exhibit : Jug
Acc. No. : MW 24/2003
Metal : Brass
Provenance : *Nanganallur*, Chennai, Tamil Nadu
Age : Late 20th century AD

Encrusted Ware

Under this head may be classed the celebrated Tanjore metal work, the art involves the works of soldering, wedging, or screwing the silver patterns and figures of Hindu deities on copper vessels. The figures are made in the famous Madras of Swami style, and the white figures in high relief on red copper ground produce an effect at once bold and striking. This and the other equally admired metal industries of Tanjore are described by Dr. Surgeon George Bidie , the Superintendent of Government Museum, Madras, Chennai (1872- 1885).

Ornamental work in copper and silver, brass and silver, and brass and copper is made at

Tanjore. The work consists of three kinds, namely, brass engraved, brass encrusted with copper, and copper encrusted with silver. Some times the brass and copper variety has also figures in tin introduced. In the engraved brass-work, first crude impressions are made with a die and by hammering. The work is then completed by cutting away the brass in the space between the figures, and giving it a granulated appearance with the graver. Finishing touches are also given to the figures. A *lota* of the common globular shape is usually the subject of this kind of adornment, and the ordinary pattern embraces panels round the bulge with figures from the popular pantheon and chaste conventional floral designs. Examined closely the figures are seen to be coarsely finished, but the general effect at a little distance is excellent.

In the copper and brassware, the vessels are made of brass and covered with figures of copper, which are fixed on the base metal by hammering creating a sort of dovetail union. After the copper crusts are put on and worked into shape, the figures are finished by the graver and a chisel. The designs on this ware are of the same character as those on the brass engraved vessels, but the figures are in bolder relief.

The encrusting of copperware with silver figures is a modern adaptation of the older art of covering brass with copper figures, and the silver is attached to the copper by the same kind of junction as that employed for fixing copper on brass. But as the metals are more valuable, great care is taken to secure a better finish, and an examination of the silver figures in high class work shows that more graver and less die or chisel work is used than in the case of copper or brass. The designs consist, as usual, of mythological figures and floral decorations, which, although in some cases are rather crowded, have yet an excellent general effect. In fact, profusion of ornament and intricate details are characteristic of all Hindu work from the embellishment of a temple to that of a *lota*, and in the case of the Tanjore ware, age improves its appearance by deepening of the hue of the copper and toning down of the colour of the silver. In North Arcot District, various patterns are stamped on the brass, and into these figures thin plates of copper or silver are pressed, and apparently fixed by hammering the edges of the brass over the other metals, so as to make a sort of dovetail. In fact, it is a crude kind of damascene work. The pieces of copper and silver thus used are introduced into the designs in a very irregular way, and the details of the figures, which are generally mythological or floral, are usually worked out by punched lines in imitation of engraving.

HANDICRAFTS

An overview

In the 19th Century colonial era, though industrialisation took a back seat, traditional handicrafts like woodcarving, metalworking and ivory carving carried on. However, the bronze casting for which Tamil Nadu is famous right from the Imperial Chola era did not stop. The traditional carving on granite by *Stapathis* and temple renovation based on this skill continued even in the 19th century AD. Though they did not have the kind of patronage, which they had under the native rulers, they still flourished thanks to the Tamil businessmen who went to countries like Malaya, Burma etc., and sent home their earnings. They patronised these traditional industries as a mark of their affluence and in keeping with their tradition. However, European influence is seen in the designs. Quaint pieces shown here like the *Aranmula* mirrors cast by the *Kannans* of Kerala are the handicraft of the border of Tamil Nadu and Kerala. They surpass the factory made products in quality.

The central showcases at the rear of the gallery show cute products like metal products. The exquisite masterpieces of metalware deserve a separate place, as the indigenous knowledge that the craftsmen of the historic past had in these handicrafts, is discussed under the section on metals, (Refer page nos: 27 to 32). The metal models in brass of the life style of the 19th century like chairs and cots reflect the items introduced by the British. They were made in the Folk art idiom. It also shows the life style of the affluent by way of the traditional ivory carvings, which were of course prevalent for many centuries in this country. It also shows household articles mainly of the 19th century AD colonial period.

An elaboration

Wood Carving

Wood is one of the important materials used by man from time immemorial. The primitive people used wood both as an instrument and a utensil. They also employed wood in the construction of their primitive dwellings. From that point of time the use of woodcarving in architecture began to develop. Pillar posts, doors, lintels, jambs, windows, etc., were made in wood. Utensils and furniture like cot, chair, table etc., were made in selected timbers. In the temples, wood was used to make ritual tools like yagna spoons. In some temples even the main deity has been carved in wood. The temple car, which was made for the street procession, provided ample scope to the master craft persons to display their skill. Many figures of Hindu deities from the Puranas and Mythological narrations were carved to embellish the temple car.

During the colonial period, in the early years of twentieth century the art of wood carving found new patrons in the *Nattukottai Chettiar* community besides the local chieftains and *Zamindars*. The *Nattukottai Chettiars* earned a lot of money in their trade in the East Asian countries like Burma, Ceylon and Singapore. They spent the money earned in Burma and Singapore in constructing temples for the Gods and Palace like houses for them. For these constructions they imported Burma teak and commissioned works like architecture woodcarvings and aesthetic carvings. It was the period of revivalism. Ancient models and designs were adapted to new conditions.

Wooden household articles and toys were also produced in large scale at that time. The *Chettinadu* house wooden kitchen wares of that time are valuable collectors' items.

A high degree of technical skill characterises the woodcarvings of Madurai. The delicate carvings in the Kalyana Mahal of the *Sri Meenakshi* Temple at Madurai and the elaborately carved temple cars speak of the excellence of wood carving as a decorative and devotional art in this part of the country. Today, while a few traditional craftsmen continue to carve splendid specimens of mythological and human figures, others are applying their skill to objects of everyday use. *Madurai* and *Virudhunagar* are famous for furnitures, such as tables; especially peg tables, exquisitely carved with traditional designs, with characteristic elephant motifs on the legs.

Architectural woodcarving of the Madras Presidency was well illustrated in the screen made for the Colonial and Indian exhibition, London, 1863. It was made of Burma teak wood constructed by a carpenter of Madras, and carved by twenty artisans from the different parts of the Presidency.

Catalogue of exhibits

- | | |
|---|---|
| <p>147) Name of the exhibit : Decorative Wooden Tray
Acc. No. : WC 1/2003
Provenance : <i>Karaikudi</i> region, Tamil Nadu</p> | <p>150) Name of the exhibit : Decorative Wooden Box (Small)
Acc. No. : WC 4/2003
Provenance : <i>Karaikudi</i> region, Tamil Nadu</p> |
| <p>148) Name of the exhibit : Decorative Wooden Coconut Scraper
Acc. No. : WC 2/2003
Provenance : <i>Karaikudi</i> region, Tamil Nadu</p> | <p>151) Name of the exhibit : The wooden frame of a Marble <i>Pallankuzhi</i>
Acc. No. : WC 5/2003
Provenance : <i>Karaikudi</i> region, Tamil Nadu</p> |
| <p>149) Name of the exhibit : Decorative Wooden Box (Big)
Acc. No. : WC 3/2003
Provenance : <i>Karaikudi</i> region, Tamil Nadu</p> | <p>152) Name of the exhibit : Decorative Wooden Box (Medium)
Acc. No. : WC 6/2003
Provenance : <i>Karaikudi</i> region, Tamil Nadu</p> |



Wood Carvings

Sl. No. 153

Sl. No. 154



A



B

Gold size Wood Carvings

A. Sl. No. 155

B. Sl. No. 156 - 159

153) Name of the exhibit : *Nataraja*

Acc. No. : WC 7/2003

Provenance : Tamil Nadu

154) Name of the exhibit : *Saraswathi*

Acc. No. : WC 8/2003

Provenance : Tamil Nadu

Polychrome and gold size woodcarving

Wood Carvings of considerable size had been painted with multicolours and such polychrome woodcarvings were made for the temple poojas. The Nataraja wood carving displayed in the gallery has the traces of colours applied to it in the earlier period. The nicely carved arch shaped lintel of the doorway remains as a good example for the gold size work prevailed in Tamil Nadu during European Companies period. Gold size is a special glue to apply either metal leaf or bronze powders as decorative gilding on an object. Both water base and oil base size were used. This decorative gilding method practised by the European craftsmen of the 18th Century AD and found its way to India through European merchants.

Catalogue of exhibits

155) Name of the exhibit : Carved Door Lintel with figures of Krishna and his Consorts

Acc. No. : WC 9/2003

Provenance : Tamil Nadu

157) Name of the exhibit : Lady playing violin

Acc. No. : WC 11/2003

Provenance : Tamil Nadu

156) Name of the exhibit : Lady carrying a fan

Acc. No. : WC 10/2003

Provenance : Tamil Nadu

158) Name of the exhibit : Lady playing Tambura

Acc. No. : WC 12/2003

Provenance : Tamil Nadu

159) Name of the exhibit : Lady carrying a fan

Acc. No. : WC 13/2003

Provenance : Tamil Nadu

Pith Articles

Pith is a spongy tissue of the stem of the plant, botanically called *Quercus suber* (Cork Oak). A traditional art-craft, the pith articles of Thanjavur, Tiruchirapalli and Madurai have a distinctive charm. Models of temples, birds, animals and mythological and human figures, and realistic studies of flowers, carved with great delicacy make excellent decorative items.

Catalogue of exhibits

160) Name of the exhibit : Hindu Temple

Acc. No. : Pi 1/2003

Provenance : Thanjavur District, Tamil Nadu

161) Name of the exhibit : Rock Temple

Acc. No. : Pi 2/2003

Provenance : Thanjavur District, Tamil Nadu

Shell Work

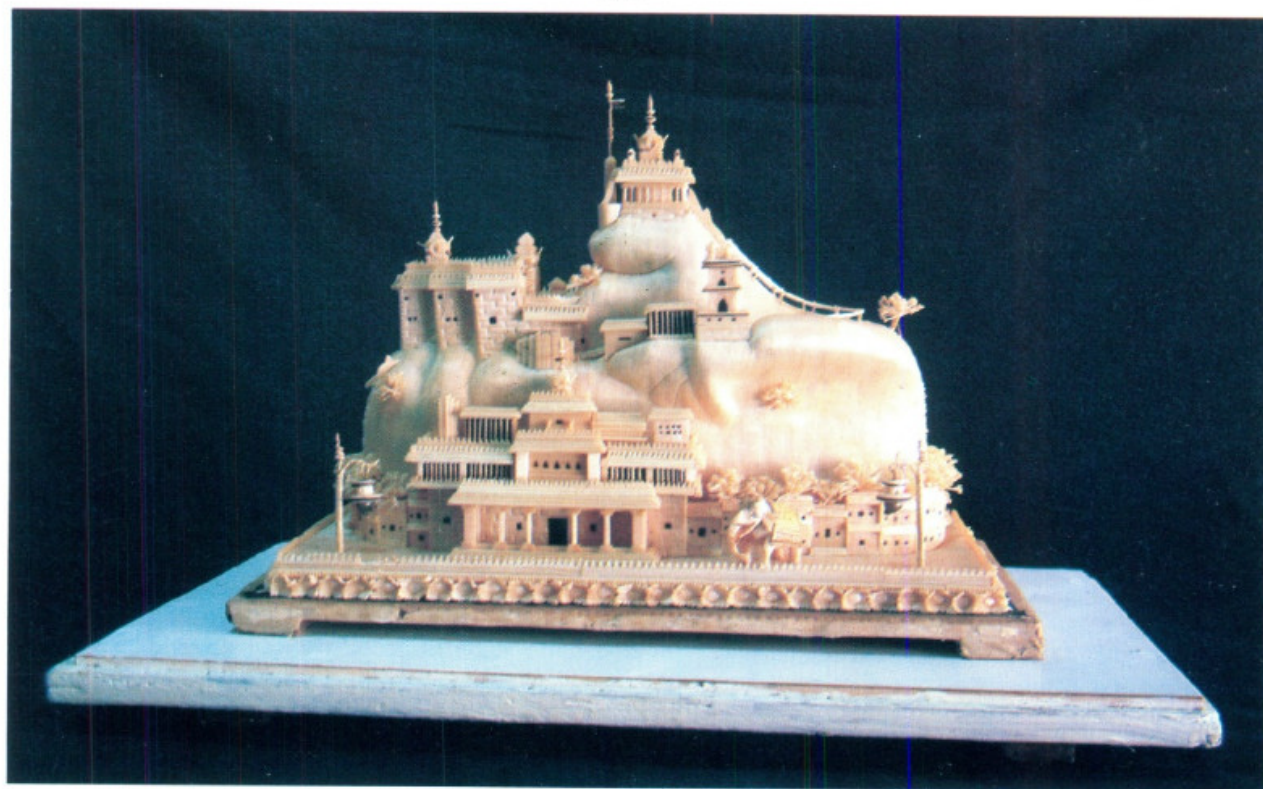
Decorative objects are made with various types of conches and shells. Functional items like lamp shades, ash-trays, paperweights incense stands and costume jewellery are made from these. In Tamil Nadu, the craft is centred in Rameswaram although it is practised in certain other places like Kanniyakumari, Nagercoil, Kizhakarai and Chennai as well.

Catalogue of exhibits

- | | |
|--|--|
| 162) Name of the exhibit : Tiger Cowrie Shell
(Cypria tigris)
Acc. No. : Sh 1/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District | Provenance : <i>Kanniyakumari</i> , Kanniyakumari District |
| 163) Name of the exhibit : Tiger Cowrie Shell
(Cypria tigris)
Acc. No. : Sh 2/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District | 169) Name of the exhibit : Bird
Acc. No. : Sh 8/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District |
| 164) Name of the exhibit : Shell Kumkum Container
Acc. No. : Sh 3/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District | 170) Name of the exhibit : Volute Shell
(Voluta speciosa)
Acc. No. : Sh 9/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District |
| 165) Name of the exhibit : Pen Stand
Acc. No. : Sh 4/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District | 171) Name of the exhibit : Key Chain made of Shell
Acc. No. : Sh 10/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District |
| 166) Name of the exhibit : Ganesha
Acc. No. : Sh 5/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District | 172) Name of the exhibit : Key Chain made of Shell
Acc. No. : Sh 11/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District |
| 167) Name of the exhibit : Spoon made of shell
Acc. No. : Sh 6/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District | 173) Name of the exhibit : Murex Shell (Murex species)
Acc. No. : Sh 12/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District |
| 168) Name of the exhibit : Miter Shell (Mitra paupercula)
Acc. No. : Sh 7/2003 | 174) Name of the exhibit : Hairclip made of Shell
Acc. No. : Sh 13/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District |



A



B

Pith Models

A. Sl. No. 160

B. Sl. No. 161



Shell Work under preparation



Shell Work and Shells

A. Sl. No. 165, 175, 166, 169, 167

B. Sl. No. 176, 173, 170, 179, 177

175) Name of the exhibit : Doll made of Shell
Acc. No. : Sh 14/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

176) Name of the exhibit : Giant Spider Conch (Lambis truncata)
Acc. No. : Sh 15/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

177) Name of the exhibit : Mantle Scallop Shell (Gloripallium pallinum)
Acc. No. : Sh 16/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

178) Name of the exhibit : Phalium Shell
Acc. No. : Sh 17/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

179) Name of the exhibit : Tulip Shell (Fasciolaria flamentosa)
Acc. No. : Sh 18/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

180) Name of the exhibit : Flower Vase made of Shell
Acc. No. : Sh 19/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

181) Name of the exhibit : Tree made of shell
Acc. No. : Sh 20/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

Catalogue of exhibits Coconut Shell

182) Name of the exhibit : Table piece (Musical Instrument)

Acc. No. : CS 1/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

183) Name of the exhibit : Pen Stand
Acc. No. : CS 2/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

184) Name of the exhibit : Wine Cup
Acc. No. : CS 3/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

185) Name of the exhibit : Pathi Stand
Acc. No. : CS 4/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

186) Name of the exhibit : Flower Vase(Big)
Acc. No. : C S 5/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

187) Name of the exhibit : Flower Vase(Small)
Acc. No. : CS 6/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

Catalogue of exhibits Bamboo and Banana Fibre

188) Name of the exhibit : Banana Fibre Plate
Acc. No. : Fi 1/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

189) Name of the exhibit : Banana Fibre Plate
Acc. No. : Fi 2/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

190) Name of the exhibit : Plate made of Arecanut Frond
Acc. No. : Fi 3/2003
Provenance : *Kanniyakumari*, Kanniyakumari District

- | | |
|---|---|
| 191) Name of the exhibit : Plate made of Arecanut Frond
Acc. No. : Fi 4/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District | 195) Name of the exhibit : Bamboo Flower Vase
Acc. No. : Fi 8/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District |
| 192) Name of the exhibit : Bowl made of Arecanut Frond
Acc. No. : Fi 5/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District | 196) Name of the exhibit : Banana Fibre Bag
Acc. No. : Fi 9/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District |
| 193) Name of the exhibit : Bamboo Basket
Acc. No. : Fi 6/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District | 197) Name of the exhibit : Banana Fibre Plate and
Bamboo Basket
Acc. No. : Fi 10/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District |
| 194) Name of the exhibit : Bamboo Basket
Acc. No. : Fi 7/2003
Provenance : <i>Kanniyakumari</i> , Kanniyakumari District | |

Ivory Carving

Ivory is a dental substance, placed by chemists between bone and horn; that variety which is distinguished by the decussating curved lines on the surface of the transverse section of the tusk is peculiar to the African and Asian elephants. The tusks of the walrus, the narwhal, and the hippopotamus, and the teeth of the same animals also furnish ivory. However the tusks of the elephant furnish the chief supply of ivory.

Regarding the elephant's tusk as ivory, we may distinguish between African and Asian ivory, by the former being, when recently cut, of a mellow, warm, transparent tint, with scarcely any appearance of grain, in which state it is called transparent or green ivory; but as the oil dries up by exposure to the air, it becomes lighter in colour. Asian ivory, when newly cut, appears more like the African, which has been long exposed to the air, and tends to become yellow by exposure. The African variety has usually a closer texture, works harder, and takes a better polish than the Asian variety. The teeth, however, of both kinds vary greatly in quality and solidity.

Ivory has an extremely hard surface and is very brittle and at the same time is close-grained. It is therefore in many respects an ideal material for use in the lathe. But in carving, it has to be treated very differently from wood. Being so extremely hard and brittle, it is necessary,

in order to carve it, to render it softer, by artificial means while the work is being carried on, but at the same time not to permanently alter its character.

In order to effect this, carvers of the 19th century adopted a method. As per that method, the ivory was wrapped in wet cloths, in which it was allowed to remain for several days, the cloths being continually re-damped. The ivory thus seasoned was found in the desired condition for carving and to cut with a consistency more like the softness of cheese or wax than the brittleness of bone. All the deep parts of the back-ground were drilled out to the required depth with small drills such as were used by goldsmiths. Due to the natural brittleness of ivory, great care and calculation have to be exercised in determining the sequence of the work when parts are fretted and parts carved so as to prevent the fretted parts breaking away under the inevitable strain of the carver's tool.

The oldest ivory figurines and relief panels now we have from South India belong to 17th and 18th centuries AD. They were commissioned by the Nayak Kings of Tamil Nadu and their subordinates. South Indian ivory carvings generally have rounded and smooth figures that contrast with the sharp free etched details of the costume headdress and jewels. The collection of the Temple Museum at Srirangam temple includes ivory figures of numerous Hindu deities. Embracing couples gracefully posed in a variety of intimate poses such as those displayed in the temple museums at Srirangam and Madurai were made on the orders of the courtly patrons of the Nayak Kingdoms. The males appear as royal figures wearing the usual Nayak Kings' headgear and jewels. The females are scantily clad with breasts, arms and thighs fully revealed. Some of the figures are painted with eye-brows and curled moustaches.

Ivory figure of *Tirumalai Naicker* (27 Cm) of Madurai, in the Chatrapati Shivaji Museum, Mumbai is a good example for the skill of the 17th century AD Madurai carver. The figure is carved with a cloth headgear, large ear rings elaborated jewelled costumes and a dagger in his left hand. The face is clearly depicted with sharply incised eyes and eyebrows. A pair of figurines in the Virginia Museum of Fine Arts, Richmond, Virginia, U.S.A. are also in similar style and size. The male figure holds a dagger in one hand and a flowering sceptre in the other. He wears the cloth headgear and jewelled ornaments similar to those found in the courtly portraits of the Nayak period. The costume of the female is deeply encrusted with jewelled necklaces and waistbands.

After the fall of the Nayak Kingdoms of Thanjavur and Madurai, local chieftains and petty rulers patronised the art of ivory carving in Tamil Nadu. During the period of English

East India Company, the princely States of South India like Mysore, Trivandrum, Cochin and Pudukkottai became the thriving centres of fine arts. Though there was no great native power in places like Thanjavur, Madurai and Ramnad, they continued to enjoy the status of cultural and fine art centres due to the glory of the previous rulers, who patronised ivory carving also in their palaces and worship.

Catalogue of exhibits

- | | |
|--|--|
| 198) Name of the exhibit : Decorative Ivory Box with Mirror
Acc. No. : IV 1/2003
Provenance : Tamil Nadu | 201) Name of the exhibit : <i>Venugopala</i>
Acc. No. : IV 4 /2003
Provenance : Tamil Nadu |
| 199) Name of the exhibit : <i>Nataraja</i>
Acc. No. : IV 2/2003
Provenance : Tamil Nadu | 202) Name of the exhibit : <i>Venugopala</i>
Acc. No. : IV 5 /2003
Provenance : Tamil Nadu |
| 200) Name of the exhibit : <i>Venugopala</i>
Acc. No. : IV 3/2003
Provenance : Tamil Nadu | 203) Name of the exhibit : Ivory Container
Acc. No. : IV6/2003
Provenance : Tamil Nadu |

Ivory Painting

With expansion of Moghul influence in the South during 18-19th century AD, Ivory painting was executed only for the royal aristocrat families at Tiruchirapalli, Tanjore and Pudukkottai. The work done at Tiruchirapalli is fairly good. Two specimens of this kind were shown at the Calcutta Exhibition in 1863 AD by one Gopalswami Raja. One of these represented a scene from the great epic Ramayana. Rama was shown here seated with Sita on a throne; on his left were his three brothers, on his right a number of Indian sages, while below were a number of monkeys in a state of adoration, and on the footstool knelt Hanuman, supporting Rama's feet. The second picture represented Krishna, an incarnation of Vishnu, as playing on his flute under his favourite *Kadamba* tree (*Anthocephalus cadamba*), with a milkmaid on each side offering him a ball of butter, while a cow was licking his feet. In the same Exhibition were shown several miniature ivory-paintings sent by one Rajagopal of Madras.

Jewellery

During the Sangam Age, pure crystallized silica or rock crystal was a very important item of Indian export to the Romans and Greeks, who used various items made out of it: ring stones,



A



B



C



D

Coconut Shell, Arecanut and Bamboo Fibre Work

A. Sl. No. 182, 183

B. Sl. No. 184, 186, 187

C. Sl. No. 191 - 193

D. Sl. No. 194, 195, 197



Ivory Carvings

Sl. No. 198, 199, 202, 203



Ivory Carvings

Sl. No. 200, 201

GOLD JEWELS

(19th Century AD.)



Naga Jadai



**Pendant with the figure
of Krishna and his consorts**



Tiger Claw Pendant

PANEL OF JEWELLERY HAND WORK

hand-balls, burning lenses, crystal cabinets, drinking cups etc as marks of wealth, luxury and extravagance' (Arun Kumar Biswas, 1996). At *Arikamedu*, diamond drills were used for drilling holes into rock crystal pieces for making various artefacts. *Kaveripoompattinam* was one of the chief emporia of India for the convex-cut garnets, earlier called 'carbuncles' or alabandens but actually almandines (Arun Kumar Biswas, 1996).

Pliny and Ptolemy mention the beryl trade from the Tamil lands. Pliny knew that the Greek equivalent of beryl, *enerros*, was derived from the Sanskrit word *Vaidurya* or *Veluriya*. During the Roman period, the Indian beryls came chiefly from *Kangayam* (Erode district), the *Nilgris* and *Padiyur* in Coimbatore district and *Vaniyambadi* in Vellore district.

By the time of Ptolemy, the sources at *Punnata* and *Ceylon* (Sri Lanka) were known and the beryl trade picked up again. Splendid six-sided beryl prisms and large quantities of Roman coins have been unearthed in Coimbatore district. The Roman ladies used to wear polished beryl 'cylindri' in their ears. Two Spanish inscriptions indicate that such commodities were highly valued. Roman bowls were decorated with them. There are engraved examples and splendid relics of the ancient Indo-Roman trade in beryl.

In 1986, beads and semi precious stones dating back to the second century BC, have been discovered on the banks of the *Noyyal* river in Erode district, Tamil Nadu.. Excavations from that place by the epigraphists of the Tamil University, *Thanjavur* yielded semi precious stone industrial sites. Recently a modern precious stone collector from Pune has collected 9.7 kg aqua marine stone near *Karur*. As per the present estimate its price is one million American Dollars.

Pearls and corals were also used for making jewellery. The *Pandya* kingdom was noted for its pearls. Pearl fishing thrived well in places like *Tuticorin* and on the Palk Straits. Ibn-Batuta gives several details about the methods of the divers who dived for pearls. He says, "The diver attaches a rope to his belt, and plunges, when he arrives at the bottom he finds the shells embedded in the sand among small stones. He detaches them with his hand or removes them with the help of the knife he has brought with him for that purpose, and places them in a leather bag around his neck. When his breath begins to give out, he jerks on the rope; the man who is holding this rope on the bank feels the movement, and pulls him up on board the boat. The divers bag is taken away from him, and the shellfish are removed; the bits of flesh inside are removed with a knife. As soon as

they come in contact with the air, they grow hard and are changed into pearls of smaller and larger sizes.

During the English East India Company period, gold and silver wares were made at *Dindigul*, *Palani* in Dindigul district and *Tanjore*. Articles in solid silver are also made by the Madras School of Art, from which a candlestick designed after the manner of a native Hindu lamp, a water-vessel in solid silver, chased and ornamented, and a spoon, with a bowl supported by parrots, the stem ending with a five-headed snake overshadowing the *Lingam*, were sent to the Colonial and Indian Exhibition, London, 1863 (Mukharji T.N., 1888).

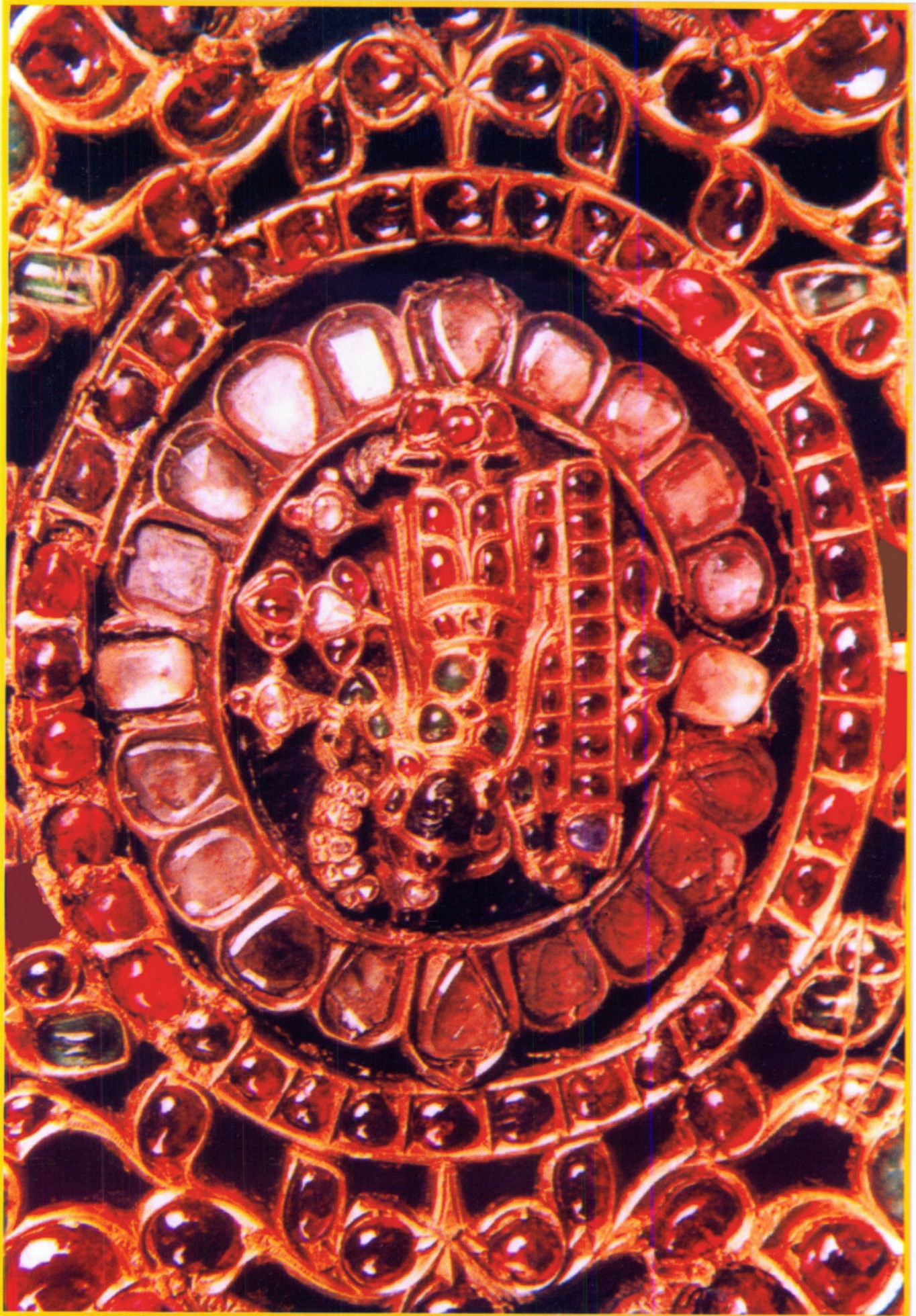
In 19th and early 20th centuries Madras jewellery acquired a great reputation all over the world, especially those made at *Tiruchirapalli*, with grotesque mythological figures, known as the Swami pattern. The shape of the articles are European, only the patterns are Indian. The principal places in which jewellery was manufactured, in the Madras Presidency were Madurai District, Chingleput District, *Salem*, *Madras*, *Malabar* and *Tanjore*. Now, *Coimbatore* and *Chennai* have become prominent centres.

A large collection both of old and modern jewellery was sent to the Colonial and Indian exhibition from the Madras Presidency. Of these, the most curious were the gold ornament to cover the *queue* (tailback) of plaited hair falling from the back of the head, which was worn by the ladies of high status and other gold and silver ornaments worn on the top of the head. The gold ear-studs worn on the distended ear lobes were no less interesting. The collection also included a splendid assortment of necklaces, wristlets, waist-chains, anklets, toe-rings, armlets, etc. Besides the Swami jewellery the favourite patterns in Madras are those in imitation of flowers. The most common patterns for bracelets are *Kalanji* and *Erukkam*, the latter being an imitation of the curious-shaped flower of *Calotropis gigantea*. Brooches are made of various patterns, such as the tiger claw, the armadillo with leaves and flower-drops, peacock, pagoda,, drum, coconut, custard fruit, plantain bunch, butterfly, elephant-tusk. Necklaces are made of *Chakram*, *Rudraksham*, butterfly, and rose patterns. The local name of different patterns of neck ornaments are-*Kundasharam*, *Arambumani Korva*, *Kumbalathali Korva*, *Ulketu*, *Nagapathali Korva*, *Elachathali Korva*, *Palachu Korva*, *Sharopali*, *Kuvalathali Korva*, *Gnali*, of ear-ornaments are- *Kundalam*, *Koppu*, *Satha Kadilathu*, *Thaka*, *Satha-thaka*.

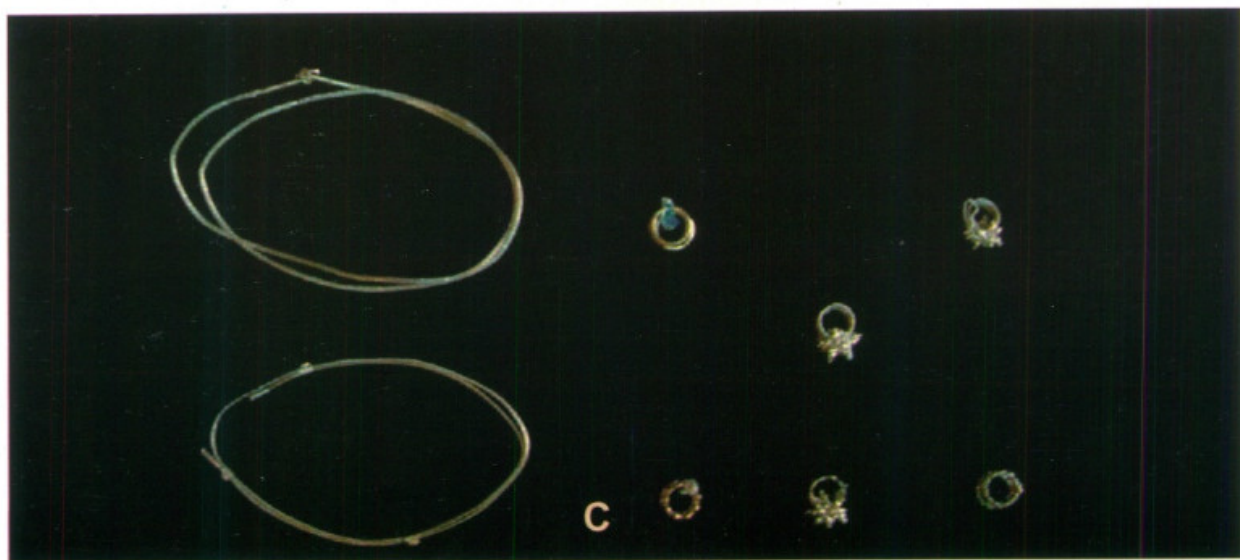
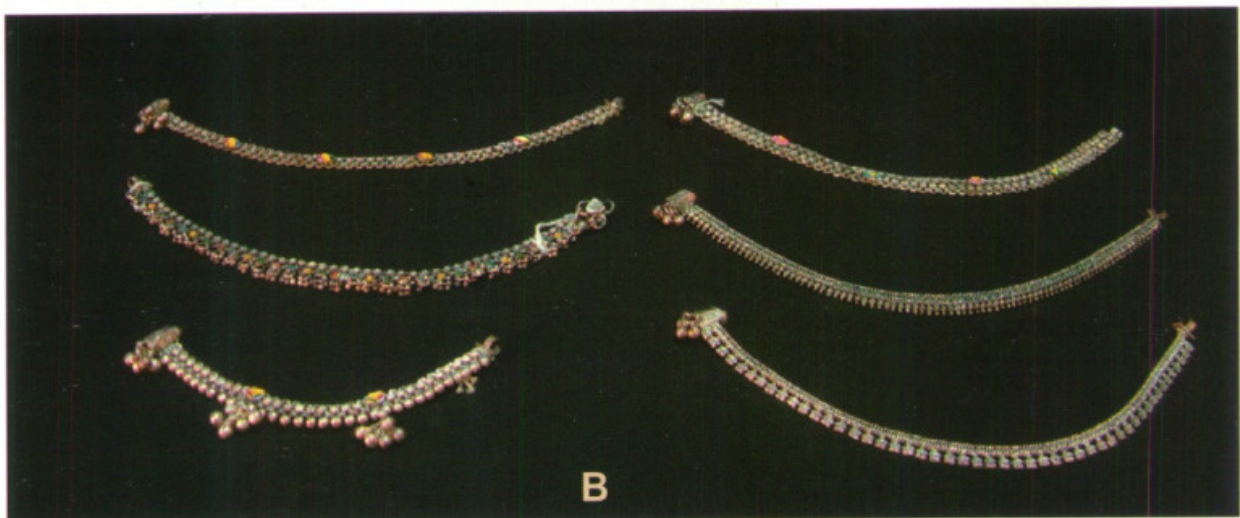
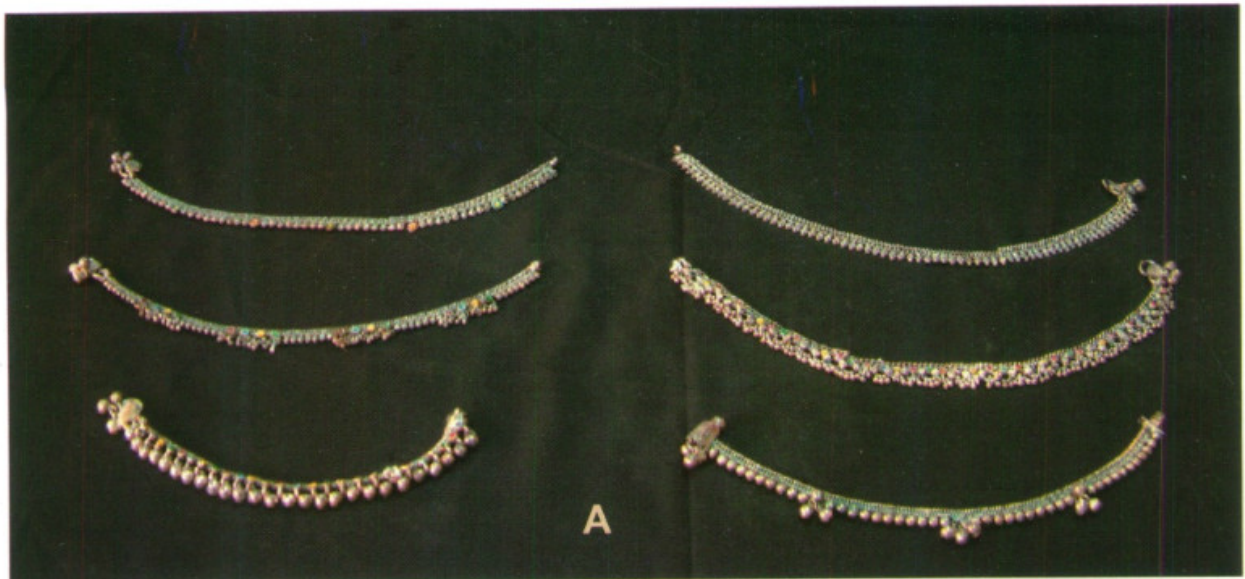
Catalogue of exhibits

- | | |
|---|---|
| 204) Name of the exhibit: <i>Chindamani Chalankai Jalar</i>
Acc. No.: Je 1/2003
Provenance : Salem District, Tamil Nadu | 213) Name of the exhibit: <i>Kudhiyam Varisai Chalankai</i>
Acc. No. : Je 10/2003
Provenance : Salem District, Tamil Nadu |
| 205) Name of the exhibit: <i>Menaka Chalankai</i>
Acc. No.: Je 2/2003
Provenance : Salem District, Tamil Nadu | 214) Name of the exhibit: <i>Kudhiyam Manonmani</i>
Acc. No. : Je 11/2003
Provenance : Salem District, Tamil Nadu |
| 206) Name of the exhibit: <i>Savitri Chalankai</i>
Acc. No.: Je 3/2003
Provenance : Salem District, Tamil Nadu | 215) Name of the exhibit: Loose <i>Bahija</i>
Acc. No. : Je 12/2003
Provenance : Salem District, Tamil Nadu |
| 207) Name of the exhibit: S. Chain <i>Arumpu</i>
Acc. No.: Je 4/2003
Provenance : Salem District, Tamil Nadu | 216) Name of the exhibit : <i>Kudhiyam Kuppa</i>
Acc. No. : Je 13/2003
Provenance : Salem District, Tamil Nadu |
| 208) Name of the exhibit: S. Chain Poo
Acc. No. : Je 5/2003
Provenance : Salem District, Tamil Nadu | 217) Name of the exhibit: <i>Kushpu Plain</i>
Acc. No. : Je 14/2003
Provenance : Salem District, Tamil Nadu |
| 209) Name of the exhibit: <i>Thandai</i>
Acc. No. : Je 6/2003
Provenance : Salem District, Tamil Nadu | 218) Name of the exhibit: <i>Kushpu Rasagulla</i>
Acc. No. : Je 15/2003
Provenance : Salem District, Tamil Nadu |
| 210) Name of the exhibit: Colour <i>Thandai</i>
Acc. No. : Je 7/2003
Provenance : Salem District, Tamil Nadu | 219) Name of the exhibit: <i>Kushpu Kuppa Three Chalankai</i>
Acc. No. : Je 16/2003
Provenance : Salem District, Tamil Nadu |
| 211) Name of the exhibit: Loose <i>Arumpu</i>
Acc. No. : Je 8/2003
Provenance : Salem District, Tamil Nadu | 220) Name of the exhibit: Double <i>Kushpu Plain</i>
Acc. No. : Je 17/2003
Provenance : Salem District, Tamil Nadu |
| 212) Name of the exhibit: <i>Kudhiyam Arumpu Rasagulla</i>
Acc. No. : Je 9/2003
Provenance : Salem District, Tamil Nadu | 221) Name of the exhibit: <i>Kudhiyam Val Arumpu Cutting</i>
Acc. No. : Je 18/2003
Provenance : Salem District, Tamil Nadu |

- 222) Name of the exhibit: *Kudhiyam Poo*
Acc. No. : Je 19/2003
Provenance : Salem District, Tamil Nadu
- 223) Name of the exhibit: *Kushpu Amarkalam*
Acc. No. : Je 20/2003
Provenance : Salem District, Tamil Nadu
- 224) Name of the exhibit: *Kushpu Arumpu*
Acc. No. : Je 21/2003
Provenance : Salem District, Tamil Nadu
- 225) Name of the exhibit: *Kushpu Kuppa*
Acc. No. : Je 22/2003
Provenance : Salem District, Tamil Nadu
- 226) Name of the exhibit: *Kushpu Double Jalar*
Acc. No. : Je 23/2003
Provenance : Salem District, Tamil Nadu
- 227) Name of the exhibit: *Kushpu Jalar*
Acc. No. : Je 24/2003
Provenance : Salem District, Tamil Nadu
- 228) Name of the exhibit: *Kushpu Three Chalankai*
Acc. No. : Je 25/2003
Provenance : Salem District, Tamil Nadu
- 229) Name of the exhibit: *Oorundai Araignan Rope*
Acc. No. : Je 26/2003
Provenance : Salem District, Tamil Nadu
- 230) Name of the exhibit: *Pattai Araignan Kodi*
Acc. No. : Je 27/2003
Provenance : Salem District, Tamil Nadu
- 231) Name of the exhibit: *Sadha Metti*
Acc. No. : Je 28/2003
Provenance : Salem District, Tamil Nadu
- 232) Name of the exhibit: *Thagadu Chella Metti*
Acc. No. : Je 29/2003
Provenance : Salem District, Tamil Nadu
- 233) Name of the exhibit: *Chella Metti*
Acc. No. : Je 30/2003
Provenance : Salem District, Tamil Nadu
- 234) Name of the exhibit: *Neli Metti*
Acc. No. : Je 31/2003
Provenance : Salem District, Tamil Nadu
- 235) Name of the exhibit: *Colour Neli Metti*
Acc. No. : Je 32/2003
Provenance : Salem District, Tamil Nadu
- 236) Name of the exhibit: *Colour Chella Metti*
Acc. No. : Je 33/2003
Provenance : Salem District, Tamil Nadu



Temple Jewellery - Ranganatha



Jewellery

A. Sl. No. 211 - 216

B. Sl. No. 217 - 222

C. Sl. No. 229, 230, 231-236

TEXTILES

An overview

Human beings started wearing the skins of the animals that they hunted to protect themselves from the fierce weather. They soon developed a sense of shame as they started living in organised societies such as nomadic tribes. Therefore, the next theme is on textiles. As civilisation further progressed by spinning cotton into thread and then weaving it into cloth came into vogue. The showcases show the development of hand spun cotton and handlooms. How looms became activated by mechanical power as power looms and then became machine spun and woven based on machinery imported from England in the 19th Century AD is then depicted. Textiles go beyond cotton and other natural fabrics to nylon, terylene and other chemical and petrochemical based products. This part is dealt with in the showcases based on the theme 'use of chemicals'. Designs on cloth were first hand printed with vegetable dyes. Photographs, illustrations and models on this theme are displayed.

An elaboration

Textiles Industry

Weaving is an ancient industry of Tamil Nadu. It was second in importance next only to agriculture. The history of South Indian textiles goes back to prehistoric times. Evidence of what appear to have been spindles was found in archaeological sites like *Paiyampalli* in the North Arcot district of Tamil Nadu. Spindles were usually made of arecanut beads or were circular potsherds pierced with a hole. *Adichchanallur* and the *Nilgiri* hills yielded the evidence of cloths datable to megalithic periods. The evidence for the continued use of the spindle for spinning yarn even in the thirteen century AD comes from the *Jaina* saint and poet, *BhavaNandhi Munivar*. In his *Nannul*, a work on tamil grammar, datable to 13th century AD; he compared poetic composition to the process of spinning, with words as cotton, ideas as the thread and his imagination as the spindle (*kadir*), he spun his yarn, the book.

Cotton textiles of very superior quality were being produced and exported from centres like Kancheepuram, Madurai and Trichy region. The evidence for this is to be found in many of the Third Sangam literary works (900 BC to 500 AD) and the Tamil twin epics *Silappadikaram* and *Manimekalai* (4th century AD to 6th century AD) give plenty of references for the fine cloths produced in their period. *Silappadikaram* refers to the weaving of cotton and silk cloth and its export from the port of *Poompuhar*, otherwise called *Kaveripoompattinam*. It describes the separate streets for

weavers, which were called *karugar vidi* (கருகர் வீதி) or *aruvai vidi* (அறுவை வீதி). Madurai also equally had prosperous and skilled weavers; *Kautilya* in his *Arthashastra* tells about the fine textiles of Madurai. In *Porunarrapadai*, a Third Sangam work we have descriptions of 'beautiful cloth so fine that the eye cannot follow the course of the yarn', and cloth bearing such delicate designs as to make it look like 'the slough of a snake' (பாம்பு சட்டை). Further they are described as soft as fresh blossoms and as light as smoke. Fine woven cloth is said to be as delicate and transparent as the vapours of milk. Garments were woven with borders or with embroidery on them. Silk cloth is referred to as *pattadai*.

Ancient Technology

The finding of a Neolithic slick-stone in the *Shervarayan* (Shevaroy Hills), and of spindle-whorls found in a *pandukal* (பண்டுகல்) tomb in Irukkur, near Salem, attest to the antiquity of weaving in Salem region. The slick-stone was apparently used to rub the rough surface of fibre fabric and put a gloss upon the surface of the cloth while still on the loom. It is said that this was a practice followed by weavers in the Northern Ireland as late as the beginning of the twentieth century. The smallness of size of the Irukkur spindle-whorl, made of baked clay, is indicative of the fineness of the yarn spun here.

Special references to textile technology in ancient South India are also to be found in other literary texts. In *Agananuru* as well as *Narrinai*, of early Christian era, the carder's bow is mentioned. The fluffy clouds in the sky after the rains are said to resemble cotton well beaten by the carder's bow. Such evidence shows that the bow for carding was in used in Tamil Nadu in the early centuries of Christian era. In *Tiruvvasagam*, the saint *Manikkavasagar* compares flights of fancy to the rapid movements of a shuttle on the loom.

The Third Sangam texts are also replete with references to Indian dyes. Indigo was a commonly used vegetable dye and cloth dyed with indigo is referred to as *nilikachchai* in *Purananaru*. Huge brick dyeing vats pertaining to the first and second centuries have been unearthed from Arikamedu in Pondicherry and Uraiyur in Tiruchirapalli, both known to be important weaving centres from the accounts of *Periplus*.

It is possible to suggest on the strength of inscriptional evidence relating to Tamil Nadu that the patterned loom in Tamil Nadu can be dated from the 11th century AD onwards. A reference

to *achchutari* occurs in 1001AD of the period of *Rajaraja Chola I*, from *Tiruvottur*, North Arcot district. The word *achchu* by itself means 'mould' or 'print' but when combined with the word *tari* (loom) it refers to the process by which the threads are tied together to form certain sequences and then the heddles are lifted by hand in the weaving of the pattern. A further reference to the *achchutari* is to be found in the period of *Rajaraja III* (thirteenth century). Further innovations in the production of the figured weave were made in the *Vijayanagar* period.

The *Jiavaka Chintamani* of the tenth century refers to both silk and cotton cloth starched with rice-water (*kanji*) and perfumed with fragrant smoke. The work also refers to *pum pattu* (பும்பட்டு), *pachchilai pattu* (பச்சிலைப்பட்டு) and *ven pattu* (வெண்பட்டு). A reference to the different types of silk in the period of *Vikrama Chola* (twelfth century AD) comes from Coimbatore. The inscription refers to *pachchai pattu*, *puliyur pattu* and *pattavala pattu* (*patola*).

Catalogue of exhibits

237) Name of the exhibit : Cone Thread	239) Name of the exhibit : Cloth bit (woven with brown cotton thread)
Acc. No. : TE 1/2003	Acc. No. : TE 3/2003
Provenance : Lakshmi Mills, Coimbatore, Tamil Nadu	Provenance : Lakshmi Mills, Coimbatore, Tamil Nadu
238) Name of the exhibit : Coloured Cotton (Brown)	
Acc. No. : TE 2/2003	
Provenance : Lakshmi Mills, Coimbatore, Tamil Nadu	

Dyeing

During the pre-industrial era when there was exclusive dependence on natural dyes, it was found that for cotton, a cellulose fibre, only two dyes provided reasonable depth and permanence of colour. These were indigo (blue) and *madder* (*Rubia tinctorum*), the latter a herbaceous plant, whose root produces a red dye. Usage of each vegetable dyeing agent was related to specific processes and techniques. Indigo was obtained from the leaves of a shrub called *Indigofera tinctoria*. The extraction of the colouring material *Indicum*, involved a complicated procedure. At the first stage Indigo tan was separated from *Indiglucin* by a process of fermentation. Continued fermentation resulted in the further separation of indigo white from Indigo tan. Indigo white was the material, which provided the dye substance, and it was only in this state that Indigo could combine with

cellulose fibre. On oxidation, Indigo white was converted into granules of Indigo blue. The commercial item sold for dyeing purposes consisted of coagulated granules of Indigo blue retailed in the form of cakes. This had once again to be reduced by fermentation into soluble Indigo white before dyeing could take place. The fabric would then be dipped into the prepared dye vat. After exposure to air, soluble Indigo white would revert to the state of insoluble Indigo blue, but by this time it would be bonded to the cotton fibre.

In India, the only method in practice in Gujarat and the South was by means of submersion in the dye vat prior to oxidation. In the South, indigo was usually the last colour to be applied in the dyeing process and to prevent unwanted colour from permeating onto other parts of the fabric, these areas would be protected by some impermeable substance, the resist. Resists could be made from various substances such as combinations of gum and mud or from wax.

The second technique related to the use of *madder* for the red dye. Cotton in its natural state could not absorb madder. It had to be treated with certain substances before the dye could bond with the fibre and remaining soluble. The first stage was that of tanning. The cloth would be dipped in a solution containing tannin. After this mordant would be applied.

Now - a - days there is a revival using vegetable dyes. Many institutions interested in indigenous knowledge do experiments to find out the traditional dyeing agents . In this gallery, we have displayed the vegetable dyeing materials and clothes coloured with such vegetable dyes. They have been tested in the rural textile wing of Gandhigram University near Dindigul.

Catalogue of exhibits

- | | |
|--|--|
| 240) Name of the exhibit : Rose wood (படாக்) | Provenance : Gandhigram, Dindigul District, Tamil Nadu |
| Acc. No. : Dy 1 /2003 | |
| Provenance : Gandhigram, Dindigul District, Tamil Nadu | 243) Name of the exhibit : Catachu (காசுக்கட்டி) |
| | Acc. No. : Dy 4/2003 |
| 241) Name of the exhibit : Indigo Coke (அவுரி சாயம்) | Provenance : Gandhigram, Dindigul District, Tamil Nadu |
| Acc. No. : Dy 2/2003 | |
| Provenance : Gandhigram, Dindigul District, Tamil Nadu | 244) Name of the exhibit : Pomegranate Rind (மரதுளை) |
| | Acc. No. : Dy 5/2003 |
| 242) Name of the exhibit : Soap nut (பூந்திக் கொட்டை) | Provenance : Gandhigram, Dindigul District, Tamil Nadu |
| Acc. No. : Dy 3/2003 | |

- 245) Name of the exhibit : Madder Root (மஞ்சிஷ்டம் வேர்) 251) Name of the exhibit : Cloth bits coloured with
 Acc. No. : Dy 6 /2003 Vegetable Dyes (SFV – A)
 Provenance : *Gandhigram*, Dindigul District, Tamil Nadu Acc. No. : Dy 12/2003
 Provenance : *Gandhigram*, Dindigul District, Tamil Nadu
- 246) Name of the exhibit : Marking nut (சேரால்
 கொட்டை)
 Acc. No. : Dy 7 /2003
 Provenance : *Gandhigram*, Dindigul District, Tamil Nadu
- 247) Name of the exhibit : Ratyan Jadh (வேம்பாடம்
 பட்டை)
 Acc. No. : Dy 8/2003
 Provenance : *Gandhigram*, Dindigul District, Tamil Nadu
- 248) Name of the exhibit : Annatto (குரங்கு
 மயிலாஞ்சி விகை)
 Acc. No. : Dy 9/2003
 Provenance : *Gandhigram*, Dindigul District, Tamil Nadu
- 249) Name of the exhibit : Cloth bits coloured with
 Vegetable Dyes (SFV–G)
 Acc. No. : Dy 10/2003
 Provenance : *Gandhigram*, Dindigul District, Tamil Nadu
- 250) Name of the exhibit : Cloth bits coloured with
 Vegetable Dyes (SFV – C)
 Acc. No. : Dy 11/2003
 Provenance : *Gandhigram*, Dindigul District, Tamil Nadu
- 252) Name of the exhibit : Cloth bits coloured with
 Vegetable Dyes (SFVM – E)
 Acc. No. : Dy 13/2003
 Provenance : *Gandhigram*, Dindigul District, Tamil Nadu
- 253) Name of the exhibit : Cloth bits coloured with
 Vegetable Dyes (DT- N)
 Acc. No. : Dy 14/2003
 Provenance : *Gandhigram*, Dindigul District, Tamil Nadu
- 254) Name of the exhibit : Cloth bits coloured with
 Vegetable Dyes (DT-L)
 Acc. No. : Dy 15/2003
 Provenance : *Gandhigram*, Dindigul District, Tamil Nadu
- 255) Name of the exhibit : Cloth bits coloured
 with Vegetable Dyes(DT-C)
 Acc. No. : Dy 16/2003
 Provenance : *Gandhigram*, Dindigul District, Tamil Nadu
- 256) Name of the exhibit : Cloth bits coloured with
 Vegetable Dyes(DT-J)
 Acc. No. : Dy 17/2003
 Provenance : *Gandhigram*, Dindigul District, Tamil Nadu

Block Printing

The coloured cloth piece is further decorated with floral and figure designs.. This has been done by various methods. Block printing is one such method, which has been used in Tamil Nadu from times immemorial. The wood block is carved with figures and it has been used to imprint the

design of the cloth using vegetable dyes. In this gallery, a few wood printing blocks have been displayed.

Catalogue of Exhibits

257) Name of the exhibit : Printing Block (Tiger)

Acc. No. : PB 1/2003

Material : Wood

Provenance : South India

258) Name of the exhibit : Printing Block (The King on the elephant)

Acc. No. : PB 2 /2003

Material : Wood

Provenance : South India

259) Name of the exhibit :

Printing Block (Four Swans with Climbers)

Acc. No. : PB 3/2003

Material : Wood

Provenance : South India

260) Name of the exhibit :

Printing Block(Floral design for border printing)

Acc. No. : PB 4 /2003

Material : Wood

Provenance : South India

261) Name of the exhibit :

Printing Block (Flame like floral design)

Acc. No. : PB 5 /2003

Material : Wood

Provenance : South India

262) Name of the exhibit :

Printing Block (Floral design)

Acc. No. : PB 6 /2003

Material : Wood

Provenance : South India

263) Name of the exhibit :

Printing Block (Peacock design)

Acc. No. : PB 7/2003

Material : Wood

Provenance : South India

Mordanting

Whereas the major difficulties associated with silk lay in the delicacy with which the yarn had to be handled during the reeling process to secure uniform thickness, those pertaining to cotton arose from the inherent difficulties associated with the bonding of dye to fibre. Before cotton fibre could absorb dye, it had to be treated with various substances so that the desired colouring ingredients could penetrate the fibre and be transformed into a permanently insoluble



B



C



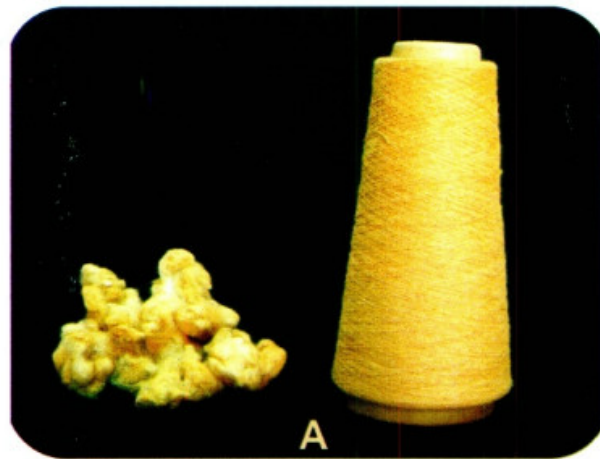
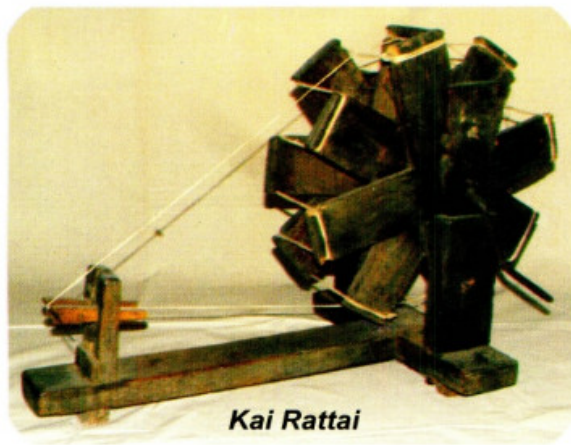
A

Textile Blocks and Block Printing

A. Sl. No. 257, 259, 263

B. Sl. No. 267

C. Sl. No. 264



B



C

Textiles

A. Sl. No. 238, 237

B. Sl. No. 268, 270, 269, 271

C. Sl. No. 272, 273

substance. This initial treatment of the cotton fabric prior to dyeing was known as the process of mordanting. Success in dyeing was, therefore, intimately connected with the degree of expertise achieved in the process of mordanting. It was because of Indian mastery over this process that the finished product enjoyed such superiority in trade.

Textile Varieties

The weavers produced various types of cloth for the requirement of the temple, the royal household and the common people. One of the main articles of weaving was the *pudavai*. The *pudavai* (*saree*) was (and still is) the desired dress of the women. The *Jivaka Chintamani* says that women wore *sarees* with folds and drapes at the end. The *pudavai* was probably not very different from what it is today, of a length between five to six yards. The main articles of clothing woven for the common man were *vetti* (*dhoti*) and *uttiriyam*, the *vetti* worn from the waist downwards being roughly one and a half yards in length and the *uttiriyam* worn to cover the upper body. Headgear was worn by the king and nobles but not perhaps by the common people. During the period of *Kulottunga Chola I* (1070-1122) reference is made to the *surrupudavai*, *niravadi pudavai*, *pavadai pudavai* (a three-yard piece), and men's apparel such as *uddi* and *uttiriyam*.

The term *pun-tukil vitanam* related to canopies with a floral design. *Chittara-cheykaipadam* (சித்திரச்செய்கைபடம்) meant figurative work. The two terms in usage at Tanjore, *tanniral ezhuthu* and *mezukal ezhuthu*, writing with water and writing with wax, are descriptive rather than denominative.

When the Europeans came, they coined their own terms. The medieval term *chint*, a vernacular term in usage in India, gave rise to the English *chintz*, the Dutch *sits* (painted) and *chits* (printed), the Portuguese *pintado*, the French *chitte* synonymous with *toile's peintes* (painted cloths) and *toile's imprimees* (printed cloths). It has to be remembered that until the early nineteenth century, any reference to 'printed' could be taken to mean *chintz*.

The Maratha ruling court at Tanjore was associated with the development of a very beautiful category of *kalamkari* (கலம்காரி) garment material which came to be called *Karrupur*. The basic material was finely woven cotton with a brocaded motif. These appear to have been woven by Saurashtra weavers patronized by the Tanjore court. The woven brocaded cloth was now further

embellished by very fine *kalamkari* motifs. The workmanship was of such an elevated order that only royalty could afford the high prices. With the decline in the fortunes of the Tanjore royal house, the tradition went into oblivion and not a trace of this activity remains today at *Kodaali Karuppur*.

Catalogue of exhibits

- | | |
|---|---|
| <p>264) Name of the exhibit : <i>Kalamkari</i> (Birds with floral design)
 Acc. No. : TV 1 /2003
 Provenance : <i>Kalakshetra</i>, Chennai, Tamil Nadu</p> | <p>268) Name of the exhibit : <i>Kodali Karuppur Saree</i> (in modern style with golden design)
 Acc. No. : TV 3/2003
 Provenance : Co-optex, <i>Sirumugai</i>, Coimbatore District, Tamil Nadu</p> |
| <p>265) Name of the exhibit : <i>Kalamkari</i> (Birds with floral design)
 Acc. No. : TV 1a /2003
 Provenance : <i>Kalakshetra</i>, Chennai, Tamil Nadu</p> | <p>269) Name of the exhibit : <i>Koorai Pudavai</i>
 Acc. No. : TV 4/2003
 Provenance : <i>Woraiyur</i>, Tiruchirapalli District, Tamil Nadu</p> |
| <p>266) Name of the exhibit : <i>Kalamkari</i> (Birds with floral design)
 Acc. No. : TV 1b /2003
 Provenance : <i>Kalakshetra</i>, Chennai, Tamil Nadu</p> | <p>270) Name of the exhibit : Checked Cotton Saree
 Acc. No. : TV 5/2003
 Provenance : Madurai District, Tamil Nadu</p> |
| <p>267) Name of the exhibit : <i>Kalamkari</i> (Paramapadam design)
 Acc. No. : TV 2 /2003
 Provenance : <i>Kalakshetra</i>, Chennai, Tamil Nadu</p> | <p>271) Name of the exhibit : Kundanchi Vetti (with Green border)
 Acc. No. : TV 6/2003
 Provenance : Co-optex, <i>Sirumugai</i>, Coimbatore District, Tamil Nadu</p> |

Silk

Inscriptional evidence dated to the Chola period points to the presence of silk weavers at *Kancheepuram*, Tamil Nadu at that time. The second traditional centre for silk weaving in this state was located at *Kumbakonam* (Thanjavur District). *Kancheepuram* and *Kumabakonam* shared a common traditional but the Kumbakonam product was acknowledged to be cheaper but less durable than its *Kancheepuram* counterpart. This resulted from the use in the joining of the *pallu* (முத்தி) portion to the main body of the *saree*. Both schools used the extra warp mechanism (the *jhungu*) for ornamentation of the *saree* borders. For ground decoration, however, the *adai* (a method of making designs on the loom by means of knotted cords with loops which are used for lowering and

raising the warp threads as per the design), a variation of the *jhala* (ஜாலா) was utilised to weave portions adorned by extra weft.

Oral tradition among the Saurashtra community in Tamil Nadu points to their migration to Tamil Nadu because of their skill in silk weaving, particularly in the field of brocade. Their migratory movements are associated with offers of court patronage, particularly those extended by *Tirumala Nayak* of Madurai (circa 1623 - 1659 A.D) and *Shahji* of Tanjore (1684 - 1712 A.D). Saurashtra may have contributed to the growth of Turkey red *chungadi* (*plangi*) dyeing at Madurai as also the weaving of *kutni* (*mashroo* - a fabric with a cotton weft and a silken warp woven in a satin weave).

Catalogue of exhibits

272) Name of the exhibit : Silk Saree with *Rudraksha*
Border (Black colour with Maroon front piece)

Acc. No. : SI 1/2003

Provenance : Weaving Design Centre,
Kancheepuram, Tamil Nadu

273) Name of the exhibit : Silk Garment used to adorn
Lord Venkateswara in *Tirupathi* (rose colour with
vaishnavite symbols)

Acc. No. : SI 2/2003

Provenance : *Ammappettai*, Salem District, Tamil Nadu

Handloom Weaving

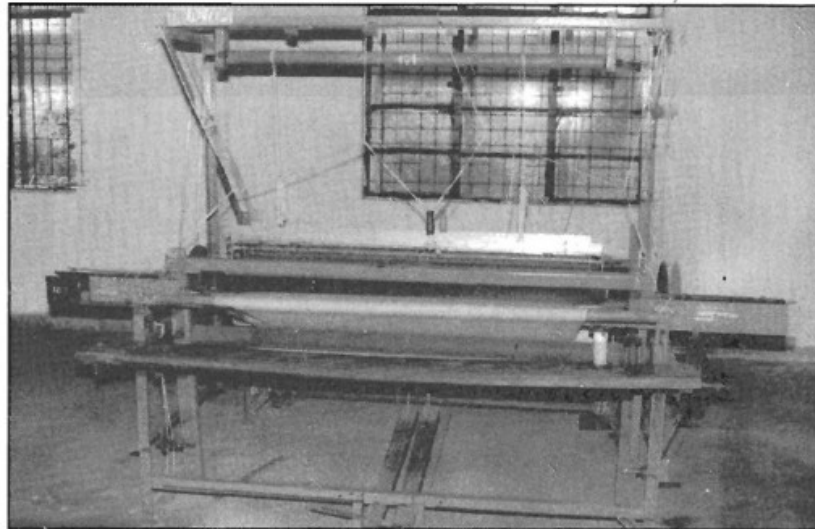
In the seventeenth century AD, the mercantile companies of England and France competed with each other to buy the products of the Salem handloom weaving. *Anandharangam Pillai*, the Pondicherry *dubashi* (interpreter) for the French competed with the British in buying textiles from Salem weavers. The British Company traded with the weavers of Tamil Nadu through their district commercial residents. The French operated from Pondicherry.

Francis Buchanan gave a list of following textile varieties produced by *Kaikolar* and *Jedar* -
1. *shillas* (thin white muslin), 2. *duputtas* (coarse and sometimes striped *shillas*), 3. *shoman* (same as above with silk borders), 4. *shalay* (thicker cotton cloth with red cotton borders), 5. *romala* (large handkerchiefs for tying round the head), 6. *parcala* (coarse plain cloth).

Experiments in improved methods of handloom weaving were commenced in 1901-1902. In 1906, a Handloom Institute was opened in Salem by Sir Arthur Lawley, the Governor of Madras Presidency, to improve the performance and living conditions of the weavers by introducing

fly-shuttle slay. Tests showed that the pit-loom fitted with fly-shuttle was as efficient as any other type of improved handloom in the market. Continued experiments were made with the fly-shuttle loom and various small improvements were added on. Ultimately the type III adopted at the Salem Factory was the old English fly-shuttle loom (invented by John Kay in 1733) modified to suit the manufacture of indigenous cloth.

The use of fly-shuttle spread rapidly. The Salem Factory began to work on a commercial scale and became very successful. Ironically as a consequence of its success, it was closed in 1910



on the protests of the Madras Chamber of Commerce. It was then decided to introduce warping mill, dobbies for weaving simple designs, and the frame loom. The jacquard machine (so called on the Name of the exhibit of Joseph Marie Jacquard of Lyons, France (1752-1834) who invented this ingenious device for weaving figures) also came into use for weaving complicated patterns.

The Madras Government organised peripatetic weaving demonstrations between 1913 and 1923. They went around the province persuading weavers to adopt fly-shuttle slay, to reduce the cost of warp preparation, to produce textiles other than plain cloth, and to weave finer and improved quality of cloth. A Textile Institute was started in Madras in 1922 to undertake studies and research in all aspects of handloom weaving, including the construction and demonstration of improved weaving appliances.

The year 1930 was the year of famine and the plight of weavers was so bad that a novel approach to the problem was tried out. The Salem Weavers Co-operative Production and Sales

Society, a first of its kind in India, was started in Gugai by the efforts of Mrs. Barbara Todd, the wife of the then Collector and the Salem Municipal Council. The municipal chairman, S Thammanna Chettiyar, was elected as the president of the Weavers Society. The membership of 364 included not only weavers but also the local luminaries such as Shri C. Vijayaragavachari and Dr. P. Subbarayan. The Society built its own dyeing factory in 1950 and a new housing colony for weavers in 1961.

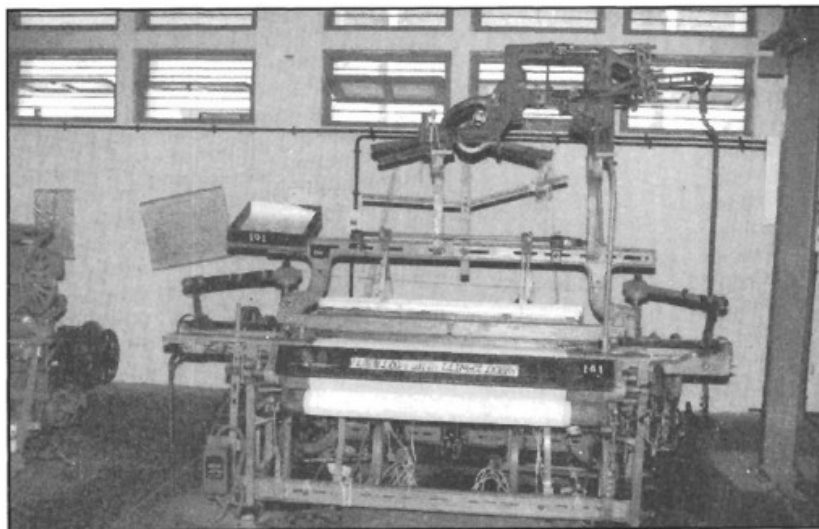
In 1988, research and development wing of the Indian Institute of Handloom Technology developed a new semi-automatic handloom. In it, the let-off and take-up are automatic. Connected with flywheels, the oscillatory movements of the slay are regulated to beat the weft yarn to its exact position, thus assuring better quality and increased productivity.

The appearance of power looms in the 1960 and their rapid spread have been at the expense of the handloom industry.

Power Weaving, Looms

Power loom weaving is done by weaving machines powered by electricity unlike the handlooms, which are powered solely by human muscles. The term "power loom" generally means a loom operated mostly by the former handloom weavers in their homes. It is to be distinguished from the looms of the large weaving factories and textile mills.

Just as the fly-shuttle changed the method and speed of production of the pit-looms during the earlier decades of this century, the power looms in the 1970s have come to replace the handlooms. By the end of the 1980s, the changeover from handloom to power loom was almost complete.



INDUSTRIES OF TAMILNADU - a general idea

In the central showcases of the display, we show the industries of Tamilnadu in the 19th and 20th centuries like leather, glass, automobiles, pump sets and sanitary ware items.

Sanitary wares was produced at Ranipet in Vellore District in Tamil Nadu. It became a famous production centre for sanitary ware even in the 19th Century AD. The European run companies brought the then latest technology of making china from England. This improved sanitation and changed the life style of the people. It increased their health and longevity, which also led to a dramatic increase in population.

An elaboration

Leather Industry

The tanner cleanses the hide and skin of superfluous matter and changes it from the soft raw stalk to tough inputrescible (not rotting) material known as leather.

Barring the literary descriptions and references it is difficult now to obtain any information regarding tanning and leather working when they were purely indigenous industries. *Trichinopoly* (Tiruchirapalli) is said to have been a great centre of the tanning trade and from there large numbers of sandals and shoes were sent out to various parts of the country. Tanneries of considerable size must have existed to supply harness and saddlery for the enormous number of irregular troops and retainers which were kept under arms by the numerous Rajahs, Zamindars and petty chieftains, who formerly exercised more or less independent sovereign powers throughout the country. The requirements of the civil population were probably small and confined chiefly to leather-thongs and ropes for the harness of draft cattle and to vessels for holding oil and ghee.

The European methods of tanning hides were first introduced by the military authorities who established tanneries for the purpose of manufacturing superior leather suitable for harness and other military equipment. Charles de Susa, a French Eurasian of Pondicherry introduced improvements in the native methods of preparing skins. He is said to have visited the Isle de Bourbon or Mauritius circa 1840 AD. He appears to have acquired there, a practical knowledge of the French processes of tanning. On his return to Pondicherry about the end of the 1840 -1850 AD,

he started a tannery there and a little later he came to Madras to set up several small tanneries, the products of which were probably exported to England. De Susa introduced many important improvements in the native processes of tanning and he was probably the first tanner in the then Madras Presidency who succeeded in producing skins which on exposure to the air showed no tendency to that fawn red discolourisation which was previously one of the distinguishing features of country-tanned leathers. This important improvement was effected by immersing the tanned skins in a bath of myrabolams for two or three days after the ordinary tanning had been completed. With raw materials at such an exceedingly low price, with cheap labour, and with the comparatively small capital outlay which was necessary to establish a tannery, it is not surprising that the vastly improved tanned skins found a ready market in Europe and that the export trade which he started grew rapidly to considerable dimensions. This process was and is still called East India Tanning.

Following De Susa's method this new tanning trade was at first largely in the hands of Eurasians but their lack of energy, improvidence and inferior business capacity enabled Muhammadan and native tanners to cut them out. The list of the exhibitors who got awards in the Madras Exhibitions of 1855 and 1857 AD contained the important tanners of the then Madras Presidency. Mr. Crowe of Madras Rangacharlu of Saidapet, Veeraswamy Mudaliyar of Palghat, Meera Pillai Labbai of Chingleput and Kasi Rao of Salem are mentioned in the list as the best tanners.

Skins and Hides

The term 'skins' is technically only applied to pelts of sheep and goats. Hides are pellicles of buffaloes and cows. Goat skins are larger, heavier and of much better texture than sheep skins. Unlike hides the majority of skins are derived from animals, which have been slaughtered for food, and the pelts are therefore in much better condition and compare favourably with similar classes of skins from other parts of the world.

There are three kinds of sheep available in the country: (1) wool sheep, (2) hair sheep and (3) short-hair sheep. The wool sheep form larger numbers. Their skins are spongy and loose and are of no great value. Out of the 9 districts already mentioned, hair sheep are only found in five districts, viz., Madras (Chennai, Tiruvallur, Kancheepuram districts), the Northern Circars (presently the area comprising the present Guntur, Kondapalli, Ellore, Rajamundhri and Chicacole of Andhrapradesh), the Ceded districts (the area comprising the present Cuddappah, Kurnool, Anantapur

and Chittur of Andhrapradesh), Coimbatore, Erode and Trichinopoly (Tiruchirapalli; presently includes Karur and Perambalur districts); and even in these districts there are considerable number of wool sheep. The short hair sheep are found only in Trichinopoly district. They yield very plump leather, which in its finished state is comparable with that of tanned goatskins.

Besides the hides and skins of what we may term 'domestic animals', the Presidency yielded a considerable number of skins of wild animals. Deer skins were by far the most numerous but there were occasionally consignments of the skins of almost all the wild animals found in the Presidency. Amongst them may be mentioned elephants, tigers and leopards. Deer skin is even now considered by Hindus an emblem of purity and it is on that account specially valued by religious leaders of Hinduism. The orthodox Hindu uses the deer skin for his seat when he offers prayers to God. Such skins are never dehaired and are preserved from decay by being dressed on the flesh side with a mixture of alum and salt. Tiger skins are regarded with some sanctity and are chiefly used by the yogis and ascetics. After Independence, especially since the 1970s, the hunting of animals has been banned. The ban is strictly enforced by the Forest and Customs Departments.

No exports are allowed. Even now periodically, consignments of snake and other skins are seized.

Skin Tanning - Pitty Tannery (a type of tannery, where tanning is done in pits)

The tanning practice with different tanners varies somewhat, and the following description is from notes made while inspecting tanneries devoted to the production of first-class work in the year 1903.

"The tanning solutions are invariably made from the bark of *Cassia auriculata*, of which about 250 lbs. are used for every 100 skins. At the Pitty Tannery in Madras which represents the highest level of tanning practice in this Presidency, the skins are kept in the first bath for six days and are then taken out and sounded. In the second bath sheep skins are kept for four days and goat skins for five days. Again they are subjected to the third bath and both kinds of skins are kept for four days. In most tanneries only two baths are employed and the period of immersion in each is usually eight days and only in the better class of tanneries are the skins scudded between the two baths. After removal from the bark solutions, the skins are practically tanned throughout. But unless subjected to further treatment, they

rapidly change their colour on exposure to sunlight. To prevent this, they are treated for two to three days in a bath of *myrabolams*, of which about 50 lbs. are used for every 100 skins. This completes the tanning and the skins are now of a very light colour, almost white, which they retain permanently. On withdrawal from the myrabolams the skins are allowed to remain in heaps and then subjected to a final scudding process, which removes the greater part of the moisture remaining in them. They are next lightly oiled with gingelly oil on the flesh side; and in good practice, about one pound of oil is used for every 10 skins; but in low class work, the skins are loaded with as much oil as they can carry, so as to increase their weight, and this over-oiling is regarded on the London market as one of the most serious defects of Madras tanning. The oiled skins are hung up in covered sheds for 24 hours to dry and are then spread over a wooden table and the grain side worked with a brass sleeker so as to smooth out wrinkles and stretch the skin uniformly in all directions. The skins are still harsh and stiff and to soften them they are staked. The stake consists of a broad steel blade fixed into an upright post about 2 feet above the ground and the skins are drawn across this blade, the cooly throwing as much of his weight as he can on to the skins. This makes the leather soft and pliable. Finally the skins are spread on a table with the grain side down and the flesh side is scraped or shaved and smoothed by rubbing with a rough brick” (சொரசொரப்பான செங்கல்).

Hide tanning

The fleshed hides are put into tubs with layers of *avaram* (*Cassia auriculata* Linn). bark between them and kept in a solution for three days, after which they are cleaned on the flesh side and then replaced for about five days in the same solution. From this they are removed to tubs containing a stronger solution of the bark in which they are immersed for about 10 to 12 days. They are treated for three days in a bath of *myrabolams* as done in the case of skins. On removal from the myrabolams the hides are hung up to dry and those for local use are well rubbed on the grain side with gingelly oil. Hides intended for export are further dressed on the flesh side with a mixture of tallow and cheap American flour (சோள மாவு) with the object of preserving them and giving them a good appearance. In the matter of finally dressing, the practice, however, varies considerably in different parts of the State. Ranipettai hides are not touched on the flesh side at all.

The East India tanning process using wattle extract and other natural materials is

environmentally friendly. In the early 1980s, this was replaced by a chemical process called Chrome Tanning. The effluents discharged from the tanneries in this process ruined the ground water and soil. This created a massive problem in Vellore District, till the Supreme Court intervened. Now, common effluent treatment plants have been set up with varying degree of success.

Catalogue of exhibits

274) Name of the exhibit : Coloured Leather
Piece (Golden)
Acc. No. : L 1/2003
Provenance : Chennai, Tamil Nadu

275) Name of the exhibit : Coloured Leather
Piece (Maroon)
Acc. No. : L 2/2003
Provenance : Chennai, Tamil Nadu

276) Name of the exhibit : Coloured Leather
Piece (Ivory)
Acc. No. : L 3/2003
Provenance : Chennai, Tamil Nadu

277) Name of the exhibit : Coloured Leather
Piece (Black)
Acc. No. : L 4/2003
Provenance : Chennai, Tamil Nadu

278) Name of the exhibit : Coloured Leather
Piece (Maroon)
Acc. No. : L 5/2003
Provenance : Chennai, Tamil Nadu

279) Name of the exhibit : Coloured Leather
Piece (Yellow)
Acc. No. : L 6/2003
Provenance : Chennai, Tamil Nadu

280) Name of the exhibit : Coloured Leather
Piece (Yellow)
Acc. No. : L 7/2003
Provenance : Chennai, Tamil Nadu

281) Name of the exhibit : Coloured Leather
Piece (Brown)
Acc. No. : L 8/2003
Provenance : Chennai, Tamil Nadu

282) Name of the exhibit : Coloured Leather
Piece (Brown)
Acc. No. : L 9/2003
Provenance : Chennai, Tamil Nadu

283) Name of the exhibit : Coloured Leather Piece(Black)
Acc. No. : L 10/2003
Provenance : Chennai, Tamil Nadu

284) Name of the exhibit : Maroon colour ladies Purse (Big)
Acc. No. : L 11/2003
Provenance : Chennai, Tamil Nadu

285) Name of the exhibit : Black colour ladies Purse (Big)
Acc. No. : L 12/2003
Provenance : Chennai, Tamil Nadu

286) Name of the exhibit : Brown colour ladies Purse (Medium)
Acc. No. : L 13/2003
Provenance : Chennai, Tamil Nadu

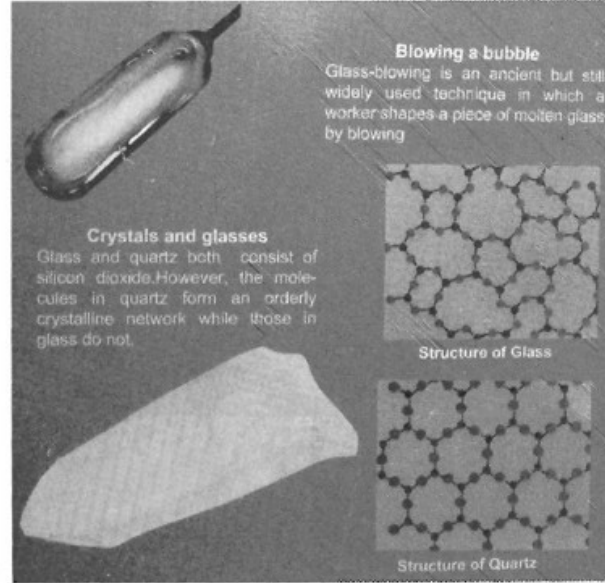
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|---|--|
| 287) Name of the exhibit : Black colour gents Purse(Big) | 292) Name of the exhibit : Shoe with lace (Black colour) |
| Acc. No. : L 14/2003 | Acc. No. : L 19/2003 |
| Provenance : Chennai, Tamil Nadu | Provenance : Chennai, Tamil Nadu |
| 288) Name of the exhibit : Black colour gents Purse (Small) | 293) Name of the exhibit : Black colour leather piece to make |
| Acc. No. : L 15/2003 | the upper part of the shoe |
| Provenance : Chennai, Tamil Nadu | Acc. No. : L 20/2003 |
| | Provenance : Chennai, Tamil Nadu |
| 289) Name of the exhibit : Black colour gents Purse (Small) | |
| Acc. No. : L 16/2003 | 294) Name of the exhibit : Brown colour leather piece to make |
| Provenance : Chennai, Tamil Nadu | the upper part of the shoe |
| | Acc. No. : L 21/2003 |
| 290) Name of the exhibit : Cut Shoe (Black colour) | Provenance : Chennai, Tamil Nadu |
| Acc. No. : L 17/2003 | |
| Provenance : Chennai, Tamil Nadu | 295) Name of the exhibit : Synthetic mould for preparing shoes |
| | Acc. No. : L 22/2003 |
| 291) Name of the exhibit : Cut Shoe (Black colour) | Provenance : Chennai, Tamil Nadu |
| Acc. No. : L 18/2003 | |
| Provenance : Chennai, Tamil Nadu | |

GLASS INDUSTRY

The manufacture of glass was known in ancient India. Glass in India was formerly made of pounded crystal. But in the 19th and early part of the 20th Century AD, the material mostly used for the manufacture of glass is impure carbonate of soda. This is produced by melting the soil containing impure carbonate of soda over a strong fire. Where such soil is not procurable, quartzose pebbles are grounded and mixed with an equal quantity of an alkaline ash. This seems to be the substance, which, according to Pliny, the Greeks employed for glass manufacture. The glass thus obtained is chiefly used in the manufacture of bangles, beads, and crackleware for perfumes. White glass is obtained by melting broken pieces of European ware, from which small vessels are sometimes made.

In the last quarter of 19th century AD Glass manufacturing thrived in large scale in North Arcot district of Tamil Nadu and large quantities of the crude glass prepared there were exported to Rangoon and elsewhere. The process followed in its preparation in these places was a very

simple one. A kind of saline efflorescence *soudu-mann*, (சவுடுமண்) which in some places is abundant on the surface of the soil, was collected and placed in pots containing about six Madras measures (முகத்தல் அளவை* a unit for measuring grains). The size of the measure differs from area to area. It is roughly equivalent to 2 litres) each. Sixty of these were built into a large clay furnace and



baked for some time until the contents had been fused into white frit, called *gasurai* (கசரை). During the process the *soudu-mann* loses half its bulk and the crude frit is turned out in the shape of hemispheres. The *soudu-mann* is a natural carbonate of soda which contains sufficient siliceous matter to make the frit. To give it colour the *gasurai* is powdered and mixed with various stones. A blue powder, probably sulphate of copper, was used; for green or *paccharai*, (பச்சைக் கல்) copper fillings; for blue-red, *ootha-kal* (ஊதா கல்), a black stone from *Conjeeveram* (Kancheepuram) called *karruppu kal* (கறுப்பு கல்), and for red, *sivappu kal* (சிவப்பு கல்), a stone known as *chembadi kal*, also from *Conjeeveram* (Kancheepuram). When coloured, the glass was broken and fused once more and then sold.

Catalogue of exhibits

296) Name of the exhibit : Green glass block
Acc. No. : G 1/2003
Provenance : *Kalahasti*, Andhra Pradesh

297) Name of the exhibit : Black glass block
Acc. No. : G 2/2003
Provenance : *Kalahasti*, Andhra Pradesh

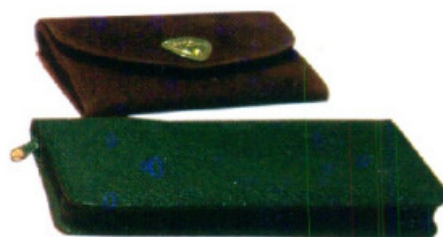


Workshop of Leather Factory



A

B



C

Leather Products

A. Sl. No. 290, 291, 292, 295

B. Sl. No. 293, 294

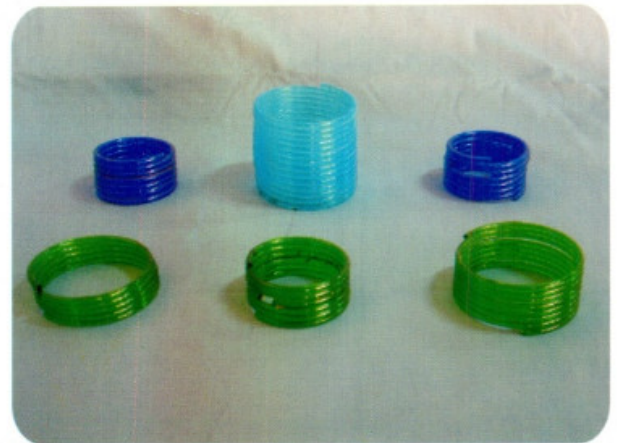
C. Sl. No. 285, 286



A



B



C



Glass Work

A. Sl. No. 298, 296; 300, 302, 299, 314

B. Sl. No. 305, 306 - 311

C. Sl. No. 312, 313

298) Name of the exhibit : Golden yellow glass block

Acc. No. : G 3/2003

Provenance : *Kalahasti*, Andhra Pradesh

Glass beads

In the manufacture of glass beads, pieces of block glass of the same colour are fused together into a single lump; and when the lump is still; hot and plastic it is pressed into a slab, which is later melted and cast into rods. One end of the rod is strongly heated over a flame and the hot molten drops from the same are collected as gatherings on a brass wire with a coating of china clay. The gatherings are shaped by turning them in hot iron moulds, into spherical or oval beads or by pressing them between hinged moulds into beads with square faces. The beads are gathered and strung together to form necklaces.

Catalogue of exhibits

299) Name of the exhibit : White glass beads

Acc. No. : GB 1/2003

Provenance : *Kasaragod*, Andhra Pradesh

301) Name of the exhibit : Yellow glass beads

Acc. No. : GB 3/2003

Provenance : *Kasaragod*, Andhra Pradesh

300) Name of the exhibit : Light green glass beads

Acc. No. : GB 2/2003

Provenance : *Kasaragod*, Andhra Pradesh

302) Name of the exhibit : Blue glass beads

Acc. No. : GB 4/2003

Provenance : Chennai, Tamilnadu

Bangles

Bangles are manufactured by strongly heating the slab in a pot furnace and pulling and drawing it out as a thin rod. While this rod is hot and flexible, it is placed on an advancing and rotating cylinder. It is allowed to cool and form a spiral. Each coil of the glass spiral thus formed is cut up into an open ring. Both the ends of each such ring are then fused over a flame. This completes the making of a bangle.

Catalogue of exhibits

303) Name of the exhibit : Mono Colour Glass Rods

Acc. No. : GL 1/2003

Provenance : Chennai, Tamil Nadu

304) Name of the exhibit : Poly Colour Glass Rods

Acc. No. : GL 2/2003

Provenance : Chennai, Tamil Nadu

- | | |
|---|---|
| 305) Name of the exhibit : Bangles (White colour with red dots)
Acc. No. : GL 3/2003
Provenance : Chennai, Tamil Nadu | 311) Name of the exhibit : Spring Bangles (Light Blue colour)
Acc. No. : GL 9/2003
Provenance : Chennai, Tamil Nadu |
| 306) Name of the exhibit : Spring Bangles (Green colour)
Acc. No. : GL 4/2003
Provenance : Chennai, Tamil Nadu | 312) Name of the exhibit : <i>Ganesha</i> Art work with Glass bits
Acc. No. : GL 10/2003
Provenance : Chennai, Tamil Nadu |
| 307) Name of the exhibit : Spring Bangles (Green colour)
Acc. No. : GL 5/2003
Provenance : Chennai, Tamil Nadu | 313) Name of the exhibit : Peacock Art work with Glass bits
Acc. No. : GL 11/2003
Provenance : Chennai, Tamil Nadu |
| 308) Name of the exhibit : Spring Bangles (Green colour)
Acc. No. : GL 6/2003
Provenance : Chennai, Tamil Nadu | 314) Name of the exhibit : <i>Ganesha</i> Tanjore style Glass Painting
Acc. No. : GL 12/2003
Provenance : Chennai, Tamil Nadu |
| 309) Name of the exhibit : Spring Bangles (Blue colour)
Acc. No. : GL 7/2003
Provenance : Chennai, Tamil Nadu | 315) Name of the exhibit : Composition Glass Painting
Acc. No. : GL 13/2003
Provenance : Chennai, Tamil Nadu |
| 310) Name of the exhibit : Spring Bangles (Blue colour)
Acc. No. : GL 8/2003
Provenance : Chennai, Tamil Nadu | |

In advancement of production techniques many types of glasses have been produced. Some of them are given below.

1. Soft glass (Soda-lime): The raw materials for this type of glass are silica (sand), calcium carbonate and soda ash. They are low in cost, resistant to devitrification and relatively resistant to water. They melt easily and hence can be easily worked when hot. They are widely used as window glasses, electric bulbs, plate-glasses, bottles, jars, building blocks and cheaper table wares, where high temperature resistance and chemical-stability are not required.

2. Hard Glass (Potash-lime) is silica (sand), calcium carbonate, and potassium carbonate

are used as raw materials to make hard glass. For this reason the glass is also known as Potash lime glass. They possess high melting-point, fuse with difficulty and are less acted upon by acids, alkalis and other solvents than ordinary glasses. So they are used for chemical apparatus, combustion tubes, etc., which are to be used for heating operations.

3. Flint Glass is made by using lead oxide, instead of calcium oxide, for fusing together with silica. Hence, this glass is referred as lead glass. These glass are used widely for high-quality table wares, optical purposes (like) lenses, etc., neon sign tubings, cathode-ray tubes, electrical insulators. Because of their high lustre they are used in art objects. High lead content glasses are used for extra-dense optical glasses for windows and shields to protect persons from X-Rays and gamma-rays in medical and atomic energy fields respectively.

Pyrex glass or jena glass - This type of glass is the most common of the hard glasses of commerce. Such glasses contain virtually only silica and boron, with a small amount of alumina and some alkali oxides. They are used extensively in industry for pipe lines for corrosive liquids, gauge glasses, superior laboratory apparatus, kitchen wares, chemical plants, television tubes, electrical insulators, etc.,

Safety glass is made by taking two or three flat sheets of glass and in-between them alternate thin layer of vinyl plastic is introduced and the whole is subjected to slight pressure. It is then heated, till the glass layers and plastic layers merge into one another to give a sandwich. On cooling, the glass becomes quite tough. When such a glass breaks, it does not fly into pieces, since the inner plastic layer tends to hold back the broken pieces of the glass. It is mostly used in automobile and aeroplane industries as wind shields, etc.

Optical or crookes glasses contain phosphorus and lead silicate, together with a little cerium oxide. The latter is capable of absorbing ultra-violet light (which is injurious to eyes). Moreover, they are given thorough homogeneity. This is secured by a very careful manufacturing process and by careful heating the molten mass for a prolonged time. In general, optical glasses have low melting-points and are relatively soft. Their chemical-resistance and durability are appreciably lower than those of ordinary glass. They are used for making lenses.

Pyroceram - This glass is other wise called as Polycrystalline Glass. It is produced by adding one or more nucleating agents (substance added to molten material to accelerate the onset and

increase the rate of crystallization) to a special or conventional glass batch, which is then shaped into desired forms. The material is then subjected to a controlled heat-treatment. The nucleating agents induce the formation of a large number of sub-microscopic crystallites, which act as centres for further crystal growth. Crystalline glass is not ductile, but has much greater impact-strength than ordinary glass. It exhibits high strength and considerable hardness and can be formed and shaped into articles by any methods of moulding.

Toughened glass - This type of glass is made by dipping articles, still hot, in an oil-bath so that some chilling takes place. By doing so, the outer layers of the articles shrink and acquire a state of compression; while the inner layers are in a state of tension. Such a glass is more elastic and capable of withstanding mechanical and thermal-shocks. When such a glass breaks, it does not fly, but is reduced to fine powder.

Insulating glass is a transparent unit, prepared by using two more plates of glass separated by 6 to 13 mm thick gap, filled up with dehydrated air and then, hermetically sealing around the edges. This provides a high insulation against heat. Thus, if such glass is used for separating apartments, it does not transmit heat and consequently, the apartments will remain cool, during summer and warm, during winter.

Laminated glass is made by pressing for bonding together two or more sheets/plates of glass with one or more alternating layer of bonding material like plastic resin, asphalt or synthetic rubber. The laminated glass is: (i) shatter-proof (i.e. its pieces do not fly off, when suddenly broken); (ii) shock-proof (i.e.) it can withstand sudden changes of temperature and even some pressure, without breaking).

Bullet-resistant laminated glass is obtained by pressing together several layers of glass with vinyl resins in alternate layers. Ordinarily, thickness of such glass varies from 12.7 mm to 76.5 mm. Even thicker types are made for specific uses. It is an ideal material for use as safety glass in aircrafts, automobiles, helicopters, submarines, etc., Bullet-resistant laminated glass finds application in making automobile wind-screens, looking windows, etc.,

On the encouragement of the famous French King Louis XIV, a Glass Company was started in France in the year 1665 AD to produce a very large size glasses for the decoration of his Palace. The company was named as Royal Glass Work Company. For the facilities needed for a glass factory,

the company moved to the village Saint Gobain and got its new name Saint Gobain. This 350 year old company came to Chennai in the year 1998 and started marketing its production on 15th July 2000. "Clear Glass" is their special product. It established a world class glass manufacturing facility near Chennai in Sriperumbudur. But for specialised glasses like toughened glass the base material travels to various cities in India like Pondicherry, Bangalore etc and is then brought back for sale in the market. The process is maintained confidentially by the company.

REFRACTORIES - MAGNESITE

Any material that can withstand high temperatures without softening or suffering a deformation in shape is called as 'refractory'. The main aim of a refractory is to confine heat (to resist loss of heat) and at the same time to resist the abrasive and corrosive action of molten metals, gases and slag (solid secure on molten metals) at high operating temperatures without undergoing softening or distortion in shape. On the basis of their chemical properties refractories are classified into three main categories such as

1. Acid refractories
2. Basic Refractories and
3. Neutral Refractories.

Acid Refractories contain acidic materials like alumina and Silica. They are not affected by acidic materials but easily attacked by basic materials. Basic Refractories contains basic materials like calcium oxide, magnesium Oxide etc., Magnesite and dolomite are important members of this category. They are not affected by basic materials but easily attacked by acidic materials. Neutral Refractories are made from weak acid or basic materials like carbon, chromites, zirconia etc. Graphite, Chromites, Zirconium and Carborundum are important members of this group.

The most important basic refractory is magnesite. As a basic refractory magnesite will readily react with acidic material. Although magnesite has a melting temperature of about 2800°C, it will readily disintegrate if it comes in contact with acidic slag or any such material with acidic character. Hence it should be used with materials of basic character. Its large-scale use is for the lining of metallurgical furnaces, especially steel melting furnaces.

The freshly broken mineral is generally of a dazzling white colour. When mixed with

magnesium chloride, it makes oxychloride, which is extensively used for floorings and as stucco. It is used in the manufacture of Epsom salt, face-powder, fire-bricks, boiler wrappings, and disinfectants. It is also useful for many industrial purposes such as a dephosphorising agent in steel industry.

The discovery of magnesite in Salem is generally attributed to Dr. Heyne. In 1825 AD, it was specially brought to the notice of the English East India Company and its use as cement was proposed. Some years later, Heyne was rewarded by the Company with a grant of 3,000 rupees in acknowledgement of what was then believed to be a discovery of great importance and value. As a result of a large number of papers appearing on the characteristics of this mineral, the Geological Survey of India examined the Chalk Hills and reported exhaustively on its occurrence and origin.

The four major companies which have exploited this mineral resource are: Burn Standard and Company Limited (Martin Burn & Co till 1970s) ; Dalmia Magnesite Corporation; Salem Magnesite Private Limited; and Tamil Nadu Magnesite.

The Basic Refractory Industry in India began with the discovery of magnesite by an English man, Henry Turner in the year 1890 AD. With his discovery; the open cast mining of magnesite began. The first wood fired kiln for calcined magnesia was exported to England. Soon the company became a unit of the Martin Burn House. Facilities were set up to produce DBM (Dead Burnt Magnesite) and basic refractory bricks to cater to the nascent steel industry in India and assay material for export.

In 1976, the Government of India took over the plant and modernised and expanded the plant so as to meet the growing demand of high quality basic refractory of the modern steel plants of the Steel Authority of India as well as those of private sector Steel Processors, non-ferrous, element and glass industries. The high silica content of the Salem magnesite remained a serious problem until M/S Burn Standard developed a process in 1982 by which the silica content could be reduced from 14 per cent to 2.5 per cent. This method involves a genetic engineering process, which involves isolation of various silicate micro organisms from different magnesite ores through silica removing strains. A series of such reactors could be installed to reduce the silica content to one per cent. When this limit is achieved, it would be possible to manufacture magnesite bricks to international standards. The Burn Standard Company Ltd, produces the refractory items made out of magnesite. Of them, the following four are described.

1. Mag-carbon bricks
2. Magnesite Bricks
3. Magnesite Chrome Brick
4. Chrome Magnesite Bricks

Magnesite bricks

Magnesite bricks are important and the most widely used basic refractories. The manufacture of magnesite bricks involves two operations. The raw material is first calcined at 800°C and dead burnt at 1700°C. In the calcining operation the major portion of the carbon-di-oxide is eliminated. This dead-burnt magnesite is powdered to a proper size, and then mixed with caustic magnesia or sulphite lye (a waste product of paper industries) or iron oxide as binding material, and then ground with water, and moulded into bricks. The bricks are then slowly heated to 1,500°C, and kept for about 8 hours at this temperature and then cooled slowly.

Magnesite bricks can be used up to 2,000°C without load, and up to 1,500° under a load of 3.5 kg/cm². They possess good crushing strength, good resistance to basic slag, very little shrinkage, but have lot of spalling (expansion of subsurface material), due to their sensitiveness to sudden changes of temperature. Their resistance to abrasion is poor. Moreover, they show a tendency to combine with water and carbon-di-oxide.

Magnesite bricks are used where high temperature is required to be maintained, together with great resistance to basic materials like molten liquids of basic nature. Their chief use is in the steel industry for the lining of basic converters, reverberatory furnaces for smelting lead, copper and antimony ores, hot zones of cement rotary kilns, refining furnaces for gold, silver and platinum, etc.,

Catalogue of exhibits

316) Name of the exhibit : Carbon Brick

Acc.No. : Ma 1/2003

Provenance : *Salem*, Tamil Nadu

317) Name of the exhibit : Calcined Magnesite

(Regular Grade Lumps)

Acc.No. : Ma 2/2003

Provenance : *Salem*, Tamil Nadu

318) Name of the exhibit : Calcined Magnesite

(Regular Grade Powder)

Acc.No. : Ma 3/2003

Provenance : *Salem*, Tamil Nadu

319) Name of the exhibit : Calcined Magnesite

(Special white lumps)

Acc.No.: Ma 4/2003

Provenance : *Salem*, Tamil Nadu

320) Name of the exhibit : Calcined Magnesite
(Special white powder)

Acc.No.: Ma 5/2003

Provenance : *Salem*, Tamil Nadu

321) Name of the exhibit : Raw Magnesite

Acc.No. : Ma 6/2003

Provenance : *Salem*, Tamil Nadu

322) Name of the exhibit : Peridotite

(Parent rock of Magnesite)

Acc.No. : Ma 7/2003

Provenance : *Salem*, Tamil Nadu

323) Name of the exhibit : Dunite

(Parent rock of Magnesite)

Acc.No. : Ma 8/2003

Provenance : *Salem*, Tamil Nadu

324) Name of the exhibit : Magnesite

Acc.No. : Ma 9/2003

Provenance : *Salem*, Tamil Nadu

IRON AND STEEL INDUSTRY

In Tamil Nadu, Kongu Region (comprising the present Coimbatore, Erode, Salem, Namakkal and Dharmapuri districts) has been the chief centre of supply of the finest steel throughout historical times. Iron was a historical mark of Tamil Nadu's contact with the western world in ancient times. The word *wootz* by which name Indian steel was known in Europe is a corrupted version of the Tamil word *urukku* meaning steel. J.M. Heath theorized that the tools used by the Egyptian sculptors might have been made of Salem steel. He also suggested that the gift of steel (30 pounds in weight) given by Porus to Alexander the Great (356-323 BC) might have come from Salem. (Rajannan Bushnagi, (1984).

In the Kodumanal excavation we have got a circular base (115 cm diameter) of a furnace, iron slag, burnt clay embedded with slag, vitrified brick bats and terracotta pipes with vitrified mouth. Large oval shaped main furnaces with more than 12 small furnaces were also excavated from this site. The important find from this site is a vitrified crucible. It is partially broken and has been found in a small furnace in in-situ position.

When the crucible was opened, the steel was found melted at the bottom with marks of crystallization on the surface, which indicated that it had undergone a complete fusion. The steel was subjected to heat a second time in a closed crucible until the metal was obtained in a suitable condition. The process of manufacturing malleable iron was by the "direct process."

In the past, Iron smelting was a thriving cottage industry in Tamil Nadu at places like Salem and Kodumanal. The agricultural implements such as field knives, kitchen knives and digging tools made in Salem and sold in the weekly markets were renowned for their high quality. The famous ironsmith of Salem, *Arunachala Acharee* put Salem on the iron map of nineteenth-century AD India. For more than ten years from 1820 AD, J.M. Heath laboured in vain to establish a large iron industry exploiting the ore of the Kanjamalai. Charcoal was used for smelting.

Le Fanu, the author of the Salem Manual describes the process that was employed during his time in Namagiripettai as follows: 'The typical village furnace or bloomery was essentially a conical mound of earth (3 to 5' high) something like an anthill'. Only the richest of the ores were used. The fuel as well as the reducing agent was charcoal. The blast furnace consisted of a hearth with a circular shaft or chimney (approximately 2-6 feet high and 2-3 feet broad). Into this, ore and charcoal were introduced and the opening closed except for the nozzle of bellows, which provided the blast. As charcoal is a purer form of carbon than coal, the iron produced by heating the ore with it was also pure. No flux seemed to have been used as only pure ore was employed. "When the smelting was over, the glowing mass, technically called the 'bloom,' was withdrawn" and hammered in order to make it solid and homogeneous. The iron slag that formed during the process of heating was tapped off from time to time through another hole and the adhering portion of it was squeezed out during the hammering. When sufficiently hammered, it was cut into pieces and sold in lumps.

In the 19th century AD, Josiah Marshall Heath, the last Commercial Resident of Salem and Coimbatore showed an abiding interest in the iron wealth of Salem. He identified the existence of Chromate of iron in the Chalk Hills and the great magnetic iron beds of the Kanjamalai Mountain. His venture in a steel enterprise ruined his life.

Iron Industry

Francis Buchanan described the Salem process of manufacturing steel as follows: 'In a crucible a wedge of iron was put with a small stem of the plant *thangheda*, a common shrub, *cassia auriculata*, and the mouth was covered with a cap of unbaked clay. It was dried and heated in a charcoal furnace air-fed with hand-bellows for four hours. It is an interesting fact that the earthen crucibles used until recently "correspond both in size and shape with those which were discovered at the ancient burial place at Adichchanallur" and the recently excavated archaeological site Kodumanal.

Catalogue of exhibits

325) Name of the exhibit : Banded Hematite with red jasper

Acc. No. : Ir 1/2003

Provenance : *Salem*, Tamil Nadu

Steel Plant, Salem

The nineteenth-century AD attempts of J.M. Heath to establish an iron factory failed for want of inexpensive, reliable, and steady supply of charcoal. In the early twentieth century AD, the absence of coal nearby made it economically impossible to start a full-fledged iron and steel industry. The discovery and mining of lignite in Neyveli in the 1950s revived hopes for the project. In 1960 AD, the state government initiated a proposal and the Government of India obtained a project report in 1964 from a consulting company. The project envisaged the establishment of a plant using of limestone from the surrounding region and reductant in the form of lignite char from Neyveli of South Arcot district. The project report conclusively established the technical feasibility and economic viability of the plant. It recommended the setting up of the plant at Kanjamalai with an initial production capacity of one and a half million tons a year, which could be extended to three million tons in stages. The estimated capital investment was ninety-five crore (950 million) rupees.

The report was studied and endorsed by the Japan Consulting Institute of Tokyo, which concluded that the proposal was in every way feasible and profitable. It also said that even a lower initial capacity of a quarter million tons a year would in no way affect the economy and profitability of the plant. This encouraged the state government to carry out in 1969 a detailed field survey for preparing a master plan for setting up a concentration and pelletisation plant.

But the Government of India deflected the proposal by establishing the present Steel Plant under the Steel Authority of India to merely process imported stainless steel rolls. The cold-rolling mill began receiving limited quantities of hot-rolled stainless steel coil from the Rourkela plant. Since then, the Salem plant has been completely dependant on high cost imports.

Modern Plant Facilities

Salem Steel Plant is equipped with modern stainless steel production lines supplied by leading



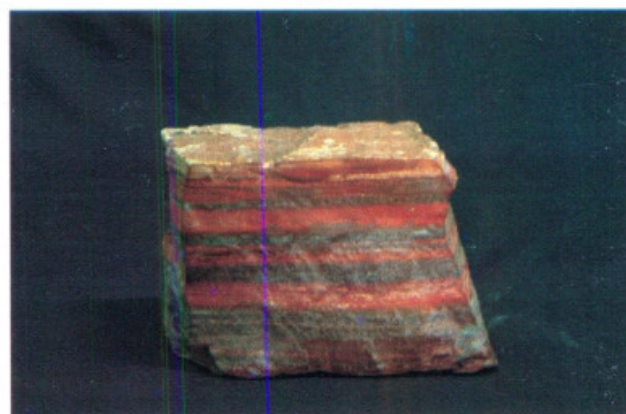
Burn Standard Company Ltd. - Salem



C



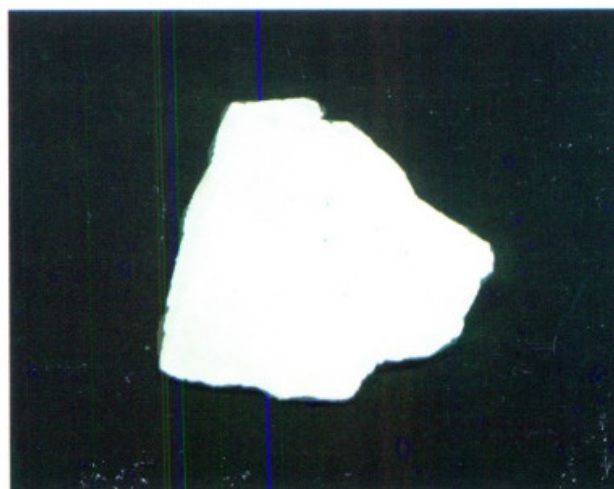
A



D



B



E

Refractories

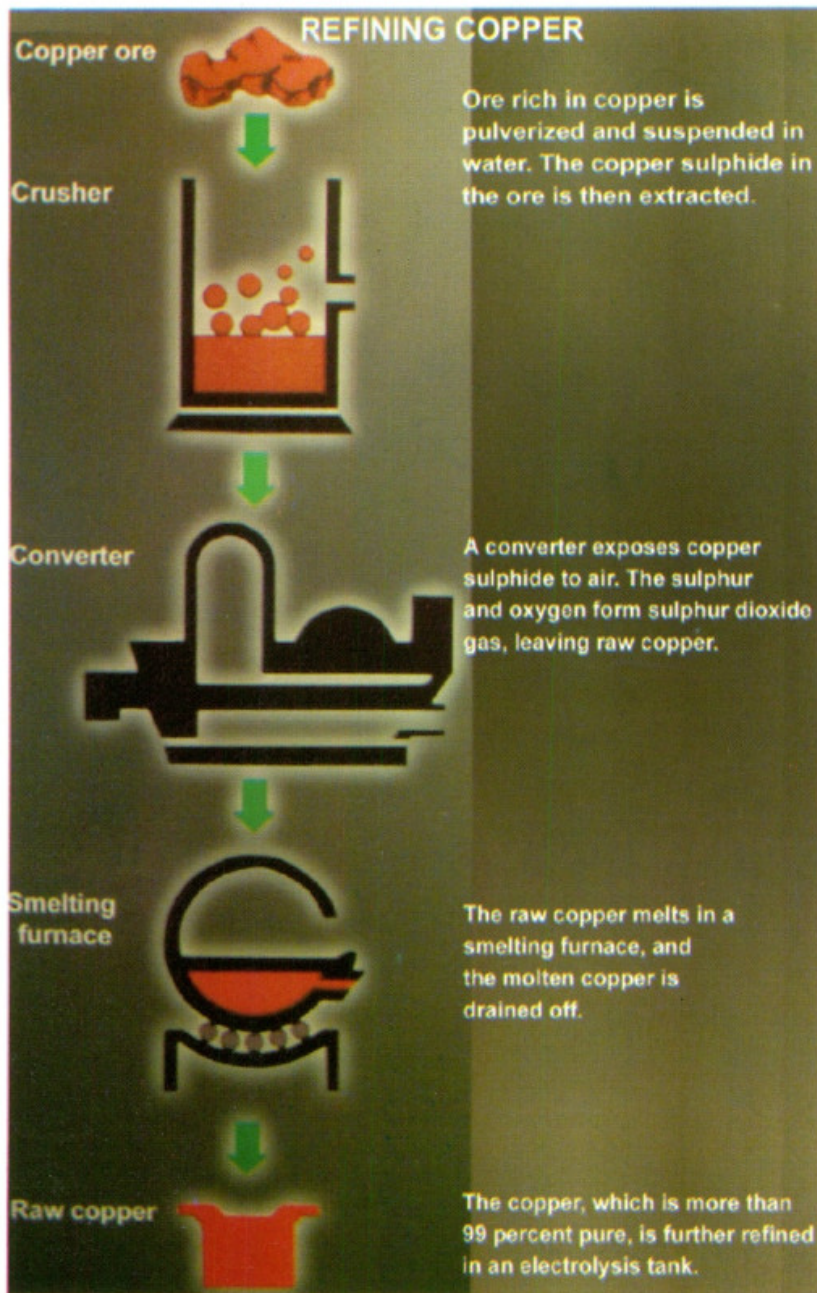
A. Sl. No. 321

B. Sl. No. 322

C. Sl. No. 323

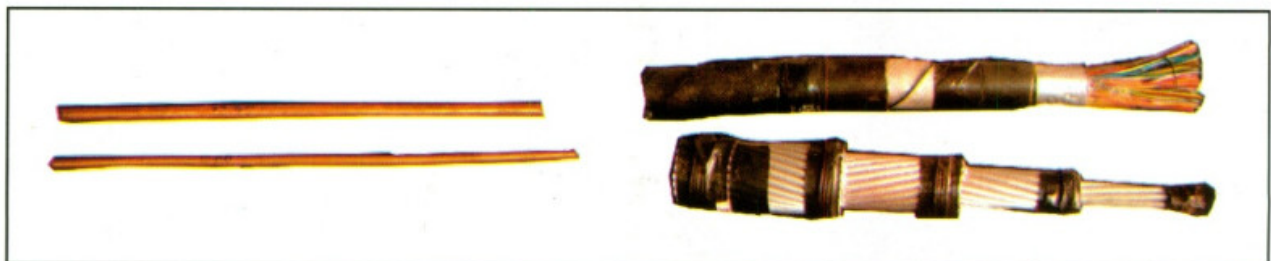
D. Sl. No. 325

E. Sl. No. 352



A

A Diagram Illustrating Refining of Copper



B

Copper Products

A. Sl. No. 101

B. Sl. No. 344, 345, 349, 355

manufacturers of steel plant equipment all over the world. Hence, stainless steel coils and sheets from the Cold Rolling Mill complex are characterised by their superior quality, precise dimensional tolerances, high degree of flatness and attractive finishes.

Computerised 20 high speed Sendzimir Mills, the most sophisticated high-speed mills of their kind, are the spearheads of the Cold Rolling Mill complex.

Coils built up in the Coil Build-up Line are processed through continuous Annealing and Pickling Lines for softening and descaling. The latest Ruthner Neutral Electrolytic Pickling process employed in these lines ensures excellent surface finish and minimum environmental pollution.

A modern 6 head Strip Grinding Line with pneumatic belt centering and weld skip-over device enables grinding a strip surface to obtain improved surface finish.

A 2-high Skin pass Mill with elongation control and constant hydraulic roll force system ensures a product of bright finish, high flatness and superior metallurgical characteristics.

A Shearing Line with 2 precision roller levellers, electronic shear and vacuum piler allows defect-free piling of the levelled cut lengths. Coils of narrow width and smaller weight are produced by a precision Slitting Line equipped with modern features like grip feed device and tension pad.

A 300 T Stretcher Leveller to produce sheets of very high degree of flatness, a Resquaring Shear, a Recoiling Line for inspection of special products, a Packing Line for slit products and Coil Packing Line are a few of the special production facilities available. In addition to common 2 D and 2B finishes (production Grades), a wide range of surface finishes including No.3, 4, 8 (production Grades) and hairline finishes can be produced by a Sheet Grinding and Polishing Line installed in this sophisticated Cold Rolling Mill Complex.

The Salem Steel Plant is the finest producer of stainless steel in India. Salem Steel Plant offers dairy, architecture, automotive, hospital, paper & pulp, petrochemicals, appliance & kitchenware, chemicals and other industries, the widest choice of stainless steels conforming to the most exacting international specifications. Some special grades also find a ready market abroad.

Catalogue of Exhibits

326) Name of the exhibit: Stainless Steel Plate Sample

(Honey Comb Finish)

Acc. No. : SS 1/2003

Provenance : Salem District, Tamil Nadu

327) Name of the exhibit: Stainless Steel Plate Sample

(Chequered Finish)

Acc. No. : SS 2/2003

Provenance : Salem District, Tamil Nadu

- 328) Name of the exhibit: Stainless Steel Plate Sample (2 B Finish)
Acc. No. : SS 3/2003
Provenance : Salem District, Tamil Nadu
- 329) Name of the exhibit: Stainless Steel Plate Sample (Stripe Finish)
Acc. No. : SS 4/2003
Provenance : Salem District, Tamil Nadu
- 330) Name of the exhibit : Stainless Steel Plate Sample (Brick work Finish)
Acc. No. : SS 5/2003
Provenance : Salem District, Tamil Nadu
- 331) Name of the exhibit : Stainless Steel Plate Sample (Leaf Finish)
Acc. No. : SS 6/2003
Provenance : Salem District, Tamil Nadu
- 332) Name of the exhibit : Stainless Steel Plate Sample (Pearl Finish)
Acc. No. : SS 7/2003
Provenance : Salem District, Tamil Nadu
- 333) Name of the exhibit : Stainless Steel Plate Sample (Canvas Finish)
Acc. No. : SS 8/2003
Provenance : Salem District, Tamil Nadu
- 334) Name of the exhibit : Stainless Steel Plate Sample (Moon Rock Finish)
Acc. No. : SS 9/2003
Provenance : Salem District, Tamil Nadu
- 335) Name of the exhibit : Stainless Steel Plate Sample (No.8 Finish)
Acc. No. : SS 10/2003
Provenance : Salem District, Tamil Nadu
- 336) Name of the exhibit : Stainless Steel Plate Sample (Hammer tone Finish)
Acc. No. : SS 11/2003
Provenance : Salem District, Tamil Nadu
- 337) Name of the exhibit : Stainless Steel Plate Sample (24 Grit Finish)
Acc. No. : SS 12/2003
Provenance : Salem District, Tamil Nadu
- 338) Name of the exhibit : Stainless Steel Plate Sample (No.4 Finish)
Acc. No. : SS 13/2003
Provenance : Salem District, Tamil Nadu
- 339) Name of the exhibit : Engraved Steel Plate (bust of His Excellency, Dr. A.P.J. Abdul Kalam, the present President of India)
Acc. No. : SS 14/2003
Material : Stainless Steel
Provenance : Salem District, Tamil Nadu
- 340) Name of the exhibit : Engraved Steel Plate (bust of Mahatma Gandhi)
Acc. No. : SS 15/2003
Material : Stainless Steel
Provenance : Salem District, Tamil Nadu
- 341) Name of the exhibit : Engraved Steel Plate (bust of Jawaharlal Nehru)
Acc. No. : SS 16/2003
Material : Stainless Steel
Provenance : Salem District, Tamil Nadu
- 342) Name of the exhibit : Chart of Hot Rolling Mill and Cold Rolling Mill
Acc. No. : SS 17/2003
Material : Stainless Steel
Provenance : Salem District, Tamil Nadu

COPPER INDUSTRY

Sterlite Copper Company in Tuticorin, Tamil Nadu is one of the biggest copper units of the state. It is the only copper factory started by a private agency. It produces one lakh tons of copper, 3 lakh tons of sulphuric acid and 1 lakh tons of phosphoric acid annually. Its contribution to the development of metal related industry is considerable.

Catalogue of exhibits

- | | |
|---|---|
| 343) Name of the exhibit : Model of the
V.V. Minerals Factory
Acc.No.: CM 01/2003
Provenance : <i>Tuticorin</i> , Tamil Nadu | 350) Name of the exhibit : ACSR - RAC
Acc.No. : CM 08/2003
Provenance : <i>Tuticorin</i> , Tamil Nadu |
| 344) Name of the exhibit : Copper Rod (Thick)
Acc.No. : CM 02/2003
Provenance : <i>Tuticorin</i> , Tamil Nadu | 351) Name of the exhibit : River sand Sample
Acc.No. : CM 09/2003
Provenance : <i>Tuticorin</i> , Tamil Nadu |
| 345) Name of the exhibit : Copper Rod (Thin)
Acc.No. : CM 03/2003
Provenance : <i>Tuticorin</i> , Tamil Nadu | 352) Name of the exhibit : Quartz Sample
Acc.No. : CM 10/2003
Provenance : <i>Tuticorin</i> , Tamil Nadu |
| 346) Name of the exhibit : Anode Copper
Acc.No. : CM 04/2003
Provenance : <i>Tuticorin</i> , Tamil Nadu | 353) Name of the exhibit : Granulated Slag
Acc.No. : CM 11/2003
Provenance : <i>Tuticorin</i> , Tamil Nadu |
| 347) Name of the exhibit : Copper Plate
Acc.No. : CM 05/2003
Provenance : <i>Tuticorin</i> , Tamil Nadu | 354) Name of the exhibit : Concentrate
Acc.No. : CM 12/2003
Provenance : <i>Tuticorin</i> , Tamil Nadu |
| 348) Name of the exhibit : ACSR Moose
Acc.No. : CM 06/2003
Provenance : <i>Tuticorin</i> , Tamil Nadu | 355) Name of the exhibit : Multi layer armoured thick Cable
Acc.No. : CM 13/2003
Provenance : <i>Tuticorin</i> , Tamil Nadu |
| 349) Name of the exhibit : ACSR - BERSIMIS
Acc.No. : CM 07/2003
Provenance : <i>Tuticorin</i> , Tamil Nadu | 356) Name of the exhibit : Multi layer armoured thin Cable
Acc.No. : CM 14/2003
Provenance : <i>Tuticorin</i> , Tamil Nadu |

357) Name of the exhibit : Illuminite ore Sample

Acc.No. : CM 15/2003

Provenance : *Tuticorin*, Tamil Nadu

358) Name of the exhibit : Garnet A+ Sample

Acc.No. : CM 16/2003

Provenance : *Tuticorin*, Tamil Nadu

359) Name of the exhibit : Garnet A Sample

Acc.No. : CM 17/2003

Provenance : *Tuticorin*, Tamil Nadu

360) Name of the exhibit : Garnet C Sample

Acc.No. : CM 18/2003

Provenance : *Tuticorin*, Tamil Nadu

361) Name of the exhibit : Garnet E Sample

Acc.No. : CM 19/2003

Provenance : *Tuticorin*, Tamil Nadu

362) Name of the exhibit : Garnet D Sample

Acc.No. : CM 20/2003

Provenance : *Tuticorin*, Tamil Nadu

363) Name of the exhibit : Garnet B Sample

Acc.No. : CM 21/2003

Provenance : *Tuticorin*, Tamil Nadu

PAPER INDUSTRY

Paper forms the basic vehicle for written communication. Etymologically the word paper owes its origin to "Papyrus" (*Cyperus papyrus*), a plant, which grew in abundance in the delta of the Nile River in Egypt. The barks and leaves of this plant were woven and pressed into a sheet and were used as writing material by the ancient Egyptians. Some of these manuscripts on papyrus can still be seen in European libraries. But the art of papermaking in its proper sense was first discovered in China and its origin in that country is traced back to 2nd Century AD. In 105 AD, a court eunuch T' sai Lun attached to the Imperial Supply Department of Emperor Ho, made a sheet of paper using, mulberry, vegetable fibres, old hemp and some other barks along with old fishnets, rags and waste, There after T' sai Lun's name was considered as "father" of paper making for a long time. Even the modern papermaking is also based on T' Sai Lun's method. The art of paper making very slowly travelled West ward through the Arabs and reached the West Asian city Samarkund in 751 AD. The establishment of the first paper mill outside China took place in Baghdad in 793 AD. during Caliph Haroun-al-Rasheed's regime.

This became possible after the capture of some Chinese paper makers at Samarkund. It took another hundred years before papermaking was commenced in Egypt, so that paper from a

source other than Papyrus began to displace it in Egypt and thereafter in the entire Middle East.

The use and manufacture of paper gradually spread along the Southern shores of Mediterranean. The art of papermaking reached Morocco in 1100 AD. from where the Moors took it across the Mediterranean to Spain.

After 16th century AD paper industry underwent revolutionary changes. Several major pulping processes were gradually developed relieving paper industry from its dependence on cotton and linter rags. Gradually the Chinese raw materials of mulberry and other such soft woods were replaced by rags and cloth. By the time paper making spread all over Europe, the art of using wood pulp was lost and was not rediscovered until the middle of the Nineteenth Century

Further innovations in manufacturing process took place, which reduced the dependency of paper industry on cotton and linen rags. These developments followed two distinct pathways. In one direction, the fibre and fibre fragments were separated from the wood structure by mechanical means. In the other, wood was treated through chemical solutions so that it dissolved and removed lignin and other wood components leaving cellulose fibres behind. The pulp produced by former methods largely shares the character of wood and this makes the product, unsuitable for white and bright paper. Therefore, for good quality paper, chemical wood pulps such as soda and sulphite pulp are used when high brightness, strength and performance are required.

The discovery of chlorine in 1774 AD led to its use for the bleaching of paper stock. Its universal adoption, however, was not quick because of difficulties in standardizing a process. In 1798, Nicolas-Louis Robert in France constructed a moving screen belt that could receive a continuous flow of stock and deliver an unbroken sheet of wet paper to a pair of squeeze rolls. This considerably altered the perspective for paper production which was hitherto being produced as one sheet at a time, the size of the sheet being limited by the size of the mould or frame that a man could lift from a vat of stock.

In spite of subsequent sophistications in machinery and equipment the basic steps in papermaking remained the same. These are: (i) a suspension of cellulosic fibre is prepared by beating it in water so that the fibres are thoroughly separated with water; (ii) paper stock is filtered on a woven screen to form matted sheet of fibre; (iii) the wet sheet is pressed and compacted to squeeze out a large proportion of water; (iv) the remaining water is removed by evaporation;

and (v) depending upon use requirements the dry paper sheet is either compressed, coated or impregnated.

In lieu of paper, in North India, a leaf of a tree, *Bhoj Patra (Betula utilis)* was used for writing books with a stylus. In South India, it was the palmyrah leaf again written on with a stylus. This was the ancient method of writing followed in India. The books were laboriously recopied by hand. This entailed both interpolations and mistakes. This is how the ancient epics like the Ramayana and Mahabharata have been handed down to us. The quality check that was built in is the oral chanting and metre, which rendered such interpolation and mistakes difficult. Also, there were competitions which also ensured accuracy.

The art of paper making reached India through Arabs who initially learnt from Chinese prisoners when they raided parts of China. Some Indian Muslims might have also learnt it directly when they visited Mongolia.

The records suggest that before the advent of machine made paper, a sizable hand made paper industry flourished in India. Paper was observed to be in common use almost all over India at the close of Emperor Akbar's reign. The improved hand made paper produced towards the latter half of the eighteenth century AD is considered of high quality and moth resistant.

The earliest efforts at mechanizing the Indian paper Industry were made by William Carey in the beginning of 19th century. William Carey started a paper mill in 1812 AD with the help of a local people. The mill was located at Serampur, West Bengal. In 1820 AD, the steam engine was introduced for operating beaters. By 1832 the first fourdrinier type machine was introduced. But in spite of all these efforts the venture did not succeed because of lack of demand for paper and Government apathy.

The manufacturing flowchart of the Seshasayee Paper Mills, Pallipalayam has been displayed in the gallery along with the raw materials used in the Mill and the books printed with the paper produced by them.

Catalogue of exhibits

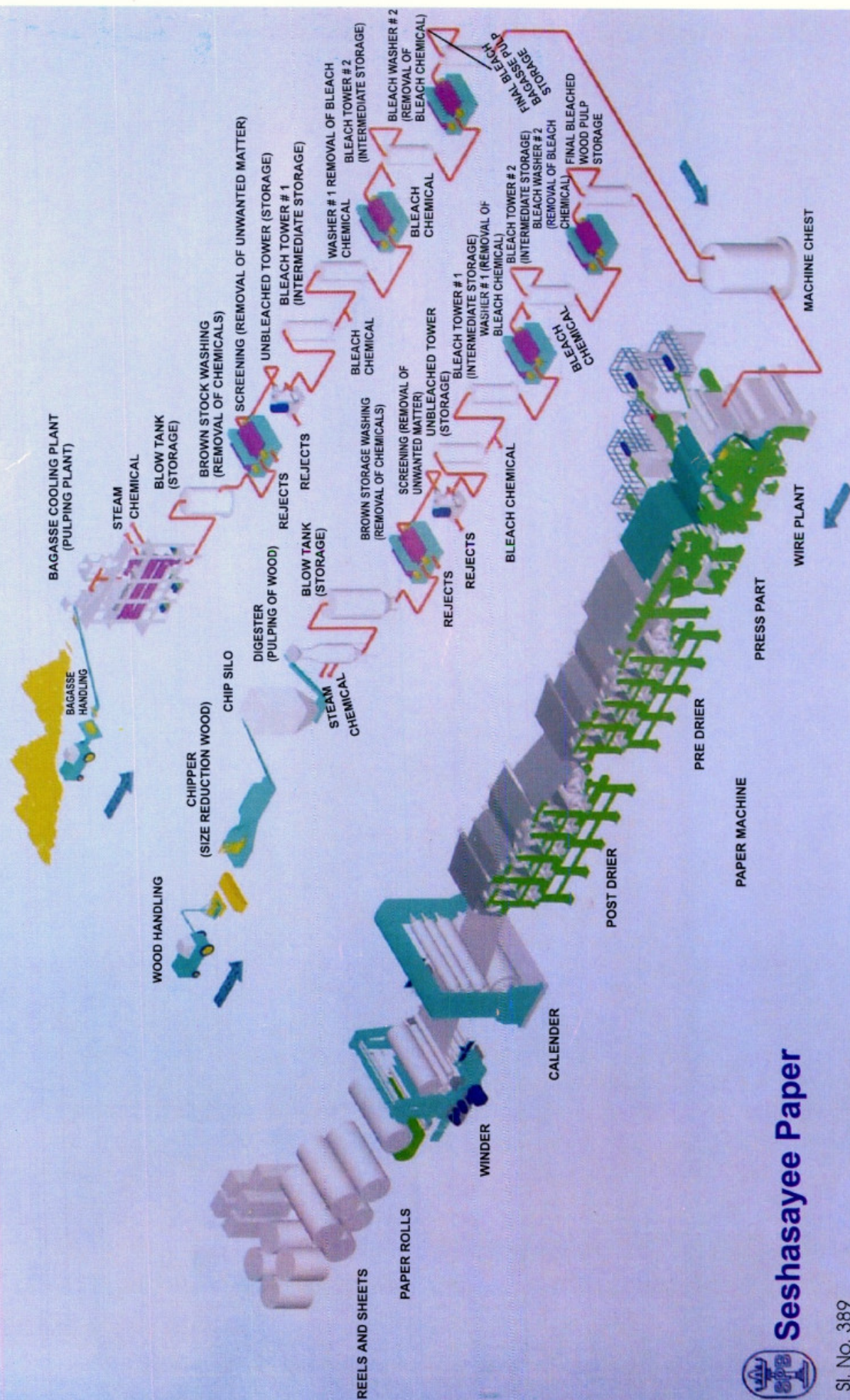
364) Name of the exhibit: The Master Mind (Book)
by R.Nagaraja
Acc. No. : PI 1/2003

365) Name of the exhibit: The Book of Vishnu
by Nandhitha Krishna
Acc. No. : PI 2/2003

- 366) Name of the exhibit: Stories Told by Mother Terasa (Book)
Compiled and edited by Edward Le Joly and Jaya Chalika
Acc. No. : PI 3/2003
- 367) Name of the exhibit: The Best of Satyajit Ray(Book)
Acc. No. : PI 4/2003
- 368) Name of the exhibit: Manila Board (Green Colour)
Acc. No. : PI 5/2003
Material : Paper Board
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 369) Name of the exhibit: Manila Board (Ash Colour)
Acc. No. : PI 6/2003
Material : Paper Board
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 370) Name of the exhibit: Manila Board (Yellow Colour)
Acc. No. : PI 7/2003
Material : Paper Board
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 371) Name of the exhibit: Manila Board (Yellow Colour)
Acc. No. : PI 8/2003
Material : Paper Board
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 372) Name of the exhibit: Manila Board (Pink Colour)
Acc. No. : PI 9/2003
Material : Paper Board
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 373) Name of the exhibit: Sundara Gandam (Book)
by Ramachandra Nivas
Acc. No. : PI 10/2003
- 374) Name of the exhibit: The Heart of India (Book)
by Mark Tully
Acc. No. : PI 11/2003
- 375) Name of the exhibit: The House of Blue mangoes (Book) by David Davidar
Acc. No. : PI 12/2003
- 376) Name of the exhibit: Mead Composition (Note Book)
Acc. No. : PI 13/2003
- 377) Name of the exhibit: Paper Sample (Pink Colour)
Acc. No. : PI 14/2003
Material : Paper
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 378) Name of the exhibit: Paper Sample – Super fine (Light Blue Colour)
Acc. No. : PI 15/2003
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 379) Name of the exhibit: Paper Sample (for book printing, green colour)
Acc. No. : PI 16/2003
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 380) Name of the exhibit: Paper Sample - MG Ribbed traft (Yellow Colour)
Acc. No. : PI 17/2003
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 381) Name of the exhibit: Ignited minds (Book) by A.P.J. Abdul Kalam
Acc. No. : PI 18/2003
Provenance : *Pallipalayam*, Salem District, Tamil Nadu

- 382) Name of the exhibit: Bagasse
Acc. No. : PI 19/2003
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 383) Name of the exhibit: Wood chips
Acc. No. : PI 20/2003
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 384) Name of the exhibit: Manila Board (for colour printing, orange colour)
Acc. No. : PI 21/2003
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 385) Name of the exhibit: Manila Board (for colour printing, rose colour)
Acc. No.: PI 22/2003
Material : Paper Board
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 386) Name of the exhibit: Manila Board (for colour printing, ivory colour)
Acc. No. : PI 23/2003
Material : Paper Board
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 387) Name of the exhibit: Manila Board (for colour printing, ivory colour)
Acc. No. : PI 24/2003
Material : Paper Board
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 388) Name of the exhibit: Manila Board (for colour printing, yellow colour)
Acc. No. : PI 25/2003
Material : Paper Board
Provenance : *Pallipalayam*, Salem District, Tamil Nadu
- 389) Name of the exhibit: Paper making process diagram chart of Seshasayee Paper Mills
Acc. No. : PI 26/2003
Material : Chart
Provenance : Seshasayee Paper Mills, *Pallipalayam*, Salem District, Tamil Nadu

TYPICAL PROCESS DIAGRAM FOR PAPER MAKING

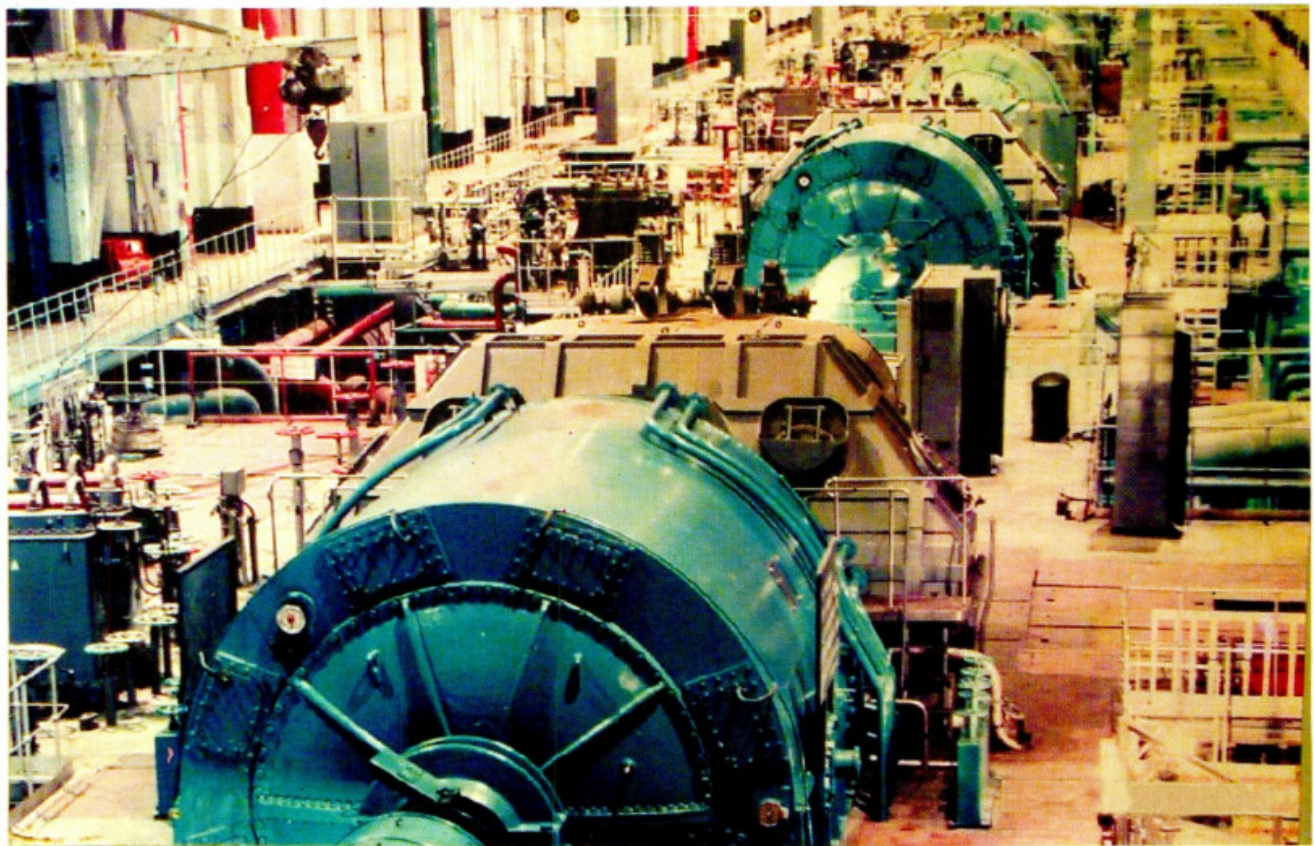


Seshasayee Paper

Sl. No. 389



View of Neyveli Thermal Power Station



Turbine Hall of Thermal Power Station - Neyveli

FOSSIL FUELS

An overview

Fuel is a combustible substance, containing carbon as main constituent, which on proper burning gives large amount of heat, which can be used economically for domestic and industrial purposes. Wood, charcoal, coal, kerosene, petrol, diesel, producer gas, oil gas, etc., are some of the fuels. The primary or main source of fuels are coals and petroleum oils. These are stored fuels available in the earth's crust and are, generally, called '**fossil fuels**'.

The fossil fuels have been classified according to their: occurrence (and preparation), and the state of aggregation. According to the first classification, we have: (a) **natural or primary fuels**, which are found in nature as such, e.g. wood, peat, coal, petroleum, natural gas, etc., (b) **artificial or secondary fuels** are those which are prepared from the primary fuels. For example, charcoal, coke, kerosene oil, diesel oil, petrol, coal gas, oil gas, producer gas, blast furnace gas, etc., The second classification is based upon their state of aggregation like (a) **solid fuels**; (b) **liquid fuels**, and (c) **gaseous fuels**.

Wood

Wood is obtained from forests. Freshly cut wood contains 25 to 50% moisture, which is reduced to about 15% on air-drying. The average composition of wood on dry moisture-free-basis is: Carbon-55%; Hydrogen-6%; Oxygen-43%; ash-1%. Wood burns readily producing a long and non-smoky flame and it leaves behind a very little amount of ash. Wood is largely used as a domestic fuel.

Coal

Coal is a highly carbonaceous matter that has been formed as a result of alteration of vegetable matter (e.g. plants) under certain favourable conditions. It is chiefly composed of Carbon, Hydrogen, Nitrogen and Oxygen besides non-combustible inorganic matter.

Origin of coal

Geologists have put forward two theories of coal formation

(1) **In situ theory**: According to this, coal formation took place at the place of vegetation itself. The great purity of many coal seams can be better explained by this theory.

(2) Drift (or transportation) theory: According to this, the trees, etc., were uprooted and transported by rivers to big lakes and other deep depressions, which got filled and blocked. These huge piles of wood then got buried underground. Under high temperature, excessive pressure, absence of oxygen, presence of bacteria, and time, the cellulosic material of wood underwent gradual decomposition with the simultaneous liberation of gases (such as CO_2 and methane). Great thicknesses of coal seams appear more reasonable on the basis of this theory.

Various types of coal commonly recognised on the basis of the degree of alternation or coalification from the parent material. They are

Wood

Peat

Lignite

Bituminous Coal

Anthracite

This progressive transformation of wood to anthracite results in: (i) decrease in the moisture content; (ii) decrease in hydrogen, oxygen, nitrogen and sulphur contents, with a corresponding rise in carbon content; (iii) decrease in volatile matter content; (iv) increase in the calorific value; (v) increase in hardness.

1. Peat is brown fibrous jelly-like mass. It is regarded as the **first stage** in the coalification of wood. Peat is mostly dug by manual labour. It is uneconomical fuel, since it may contain as much as 80-90% water, but on air-drying (after 1 to 2 months drying), it burns freely. The average composition of air-dried peat is: C=57%; H=6%; N=35%; ash content = 2.5 to 6%. Nilgiri hills in Tamil Nadu has peat deposits.

2. Lignites (brown coals) are soft, brown coloured variety of **lowest rank coals**, which consist of vegetable matter decomposed more than that in peat. Lignite is compact in texture, containing 20 to 60% moisture and on air-drying; it breaks up into small pieces. Air-dried lignite contains: C=60 to 70%; O=20%. Lignite burns with long smoky flame.

In India, lignite deposits occur in Assam, Kashmir, Rajasthan (at Palana) and at Neyveli in Tamil Nadu. Lignites are usually dried, powdered and pressed into small briquettes and then burnt

as household fuel and for steam raising (boiler fuel). Its most important use is in the manufacture of producer gas.

3. **Bituminous coals (common coals)** are pitch-black to dark-grey coals, which usually soil hands. They show a **laminated structure** of alternate very bright and dull layers. The common bituminous coals are sub-classified on the basis of carbon content:

a) Sub-bituminous coals are black in colour and more homogeneous and smooth in appearance. Their moisture and volatile contents are high; and on exposure in air, these crumble into small pieces. They are non-caking coals. Carbon content varies from 75 to 83% and oxygen content from 10 to 20%.

b) Bituminous coals show a typically banded appearance and C content ranges from 78 to 90% and volatile matter 20 to 45%. Coal of this class is used in the large quantities in industries for making metallurgical coke, coal gas, and for steam raising and domestic heating.

c) Semi-bituminous coals include varieties of bituminous coals that are rich in carbon (90-95%) and have low volatile matter. These are used for coke manufacture.

In India, bituminous coals reserves are located at Bihar, Bengal, Madhya Pradesh and Orissa.

4. **Anthracite** is a class of **highest rank coal**, containing highest percentage of carbon (92-98%) and has lowest volatile matter and moisture contents. They are hardest of all kinds of coals, quite dense and lustrous in appearance. Their volatile matter is less than 8% therefore they ignite with difficulty, burn without any smoke and give intense local heating. They possess no caking power.

Neyveli Lignite

Lignite occurring at Neyveli is of drift origin, i.e. vegetation, which grew at some place, drifted and was deposited at the present place where it got converted into lignite. Lignite seams occur at a depth of 180 feet from the surface. Nowhere does it outcrop on the surface. The seams are lenticular and wavy in character. The thickness of the seams vary from 13 feet to 80 feet. Below the lignite seam there are artesian aquifers under high pressure. Kaolin, refractory clay and pottery clay occur in the over-burden above the seam.

Reserves are estimated to be about 2,000 million tons over a total area of 100 square miles. It has a very high moisture content and a very low ash content. Due to the high moisture content and the property of spontaneous combustion it cannot be stored or transported over long distances. In order to facilitate this they are made into the form of briquettes. On carbonising the briquettes various by-products such as char fines, middle oil, tar, phenol, etc., are obtained.

Catalogue of exhibits

390) Name of the exhibit : Lignite

Acc. No. : NE 1/2003

Provenance : *Neyveli*, Cuddalore District, Tamil Nadu

391) Name of the exhibit : Lignite

Acc. No. : NE 2/2003

Provenance : *Neyveli*, Cuddalore District, Tamil Nadu

CHEMICAL INDUSTRY

An overview

Making steel and smelting iron ore in the modern era is closely associated with chemicals. Therefore, the next section of the gallery displays chemical products. Papermaking, polymer and modern petro-chemical products are shown. As stated earlier (Refer page no. - 102) paper also started the printing revolution, which transformed the palm leaf manuscripts into mass knowledge. It ushered in the knowledge revolution. Crude Oil, a fossil fuel, also created petroleum based fuels like Petrol, diesel, kerosene etc that dramatically changed cooking, heating and transport. These are also shown in the display.

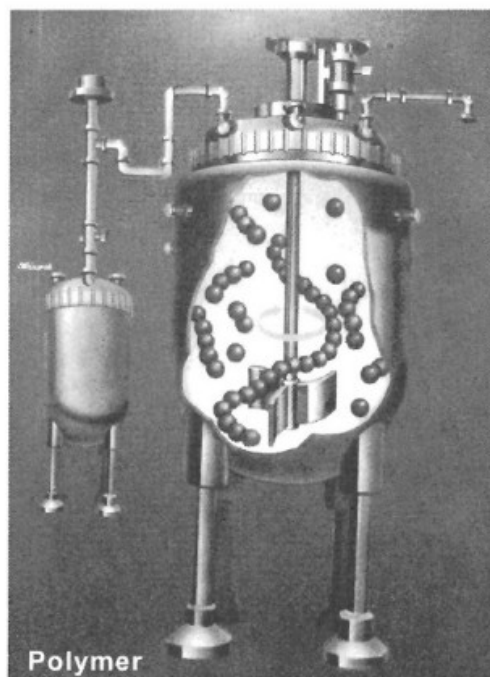
An elaboration

Polymers

Polymers are solids composed of long molecular chains. The long molecular chains are made up of relatively simple molecules called monomers. The most common polymers are made from compounds of carbon and consist of long molecular chains with strong bonds joining the atoms in the chain. Along with natural polymers, we have synthetic organic polymers and synthetic inorganic polymers.

Polymers can be classified as elastomers (rubber), plastics and fibres (nylon and terylene).

When we heat polymers, they pass through five general states: glassy, leathery, rubbery, viscous rubbery and liquid. Polymers have high tensile strength and modulus of elasticity. They are all non-magnetic solids.



Elastomers (Rubber)

All natural and synthetic rubbers fall in the category of elastomers. The natural rubber is obtained from the tree, *Hevea brasiliensis* in the form of a milky liquid known as latex. It is polyisoprene which is unsaturated linear molecule. During vulcanisation (addition of sulphur) some cross-links between adjacent molecules are formed and hence hardness is increased. Ebonite is a full-vulcanised rubber. Synthetic rubbers are made from the coagulum of a polymerisation process. These possess different chemical structures but resemble natural rubber in many physical properties.

The significant features and characteristic of elastomeric behaviour are:

- i) The material is soft and its elastic modulus is low.
- ii) Very high strains are possible
- iii) The strain is reversible.
- iv) The material is non-crystalline and is above its glass transition temperature.

Natural Rubber

Natural Rubber is obtained from latex which is a milky emulsion tapped from the bark of hevea trees. The solids in the latex are coagulated by adding either acetic acid or formic acid. They are then separated from the liquid by squeezing between the rolls. The sheets of rubber are then washed and dried.

The surgical gloves prepared from the natural rubber latex by the Kanam Latex Industries Pvt. Ltd, Nagercoil have been displayed in the gallery.

Catalogue of exhibits

392) Name of the exhibit : Powder free Surgical Gloves (for right hand) Acc. No. : NR 1/2003 Size : No.7 Provenance : <i>Nagercoil</i> , Kanniyakumari District, Tamil Nadu	394) Name of the exhibit : Pre Powder Surgical Gloves (for right hand) Acc. No. : NR 3/2003 Size : No.8 Provenance : <i>Nagercoil</i> , Kanniyakumari District, Tamil Nadu
393) Name of the exhibit : Powder Free Surgical Gloves (for left hand) Acc. No. : NR 2/2003 Size : No.7 Provenance : <i>Nagercoil</i> , Kanniyakumari District, Tamil Nadu	395) Name of the exhibit : Pre Powder Surgical Gloves (for left hand) Acc. No. : NR 4/2003 Size : No.8 Provenance : <i>Nagercoil</i> , Kanniyakumari District, Tamil Nadu

Vulcanisation

The crude rubber is then vulcanised by combining it chemically with sulphur at an elevated temperature. Vulcanisation improves physical properties of rubber to a great extent, giving it much higher tensile strength, a smaller permanent set, higher resistance to solvents, and less susceptibility to temperature changes. Vulcanisation of Rubber is a curing reaction by which rubber reacts with the setting reagents (chemicals). By vulcanisation, cross linking is produced by addition of sulphur. Increased cross-linking gives increased stiffness and reduced elongation. Sulphur is known as the vulcaniser. The effectiveness of vulcanisation can be enhanced by the use of accelerators, which are organic chemicals.

The mechanical, electrical and chemical properties of hard natural rubber are excellent but are impaired by exposure to sunlight and excessive contact with oil and other organic liquids. Metal inserts must be painted with some heat-resistant coating which does not react with sulphur.

Synthetic Rubbers

1. Butadiene Rubbers (BR)

These rubbers are made from butadiene by use of catalysts. They have low heat generation, high resilience and good low temperature properties. They have poor tensile strength and poor tear resistance for which reasons they are seldom used on their own but generally blended with other elastomers. Since they have a low heat build-up they are used for vehicle tyres-blended with natural rubber for truck tyres and with SBR for motor car tyres. BR imparts good tread wear to tyres and also have good low temperature properties. These rubbers are also used as a sealant compound in caulking

2. Butadiene-Styrene Rubbers (BSR)

Rubbers of this type are co-polymers of butadiene and styrene. Although natural rubber is superior with respect to lower heat, build up during flexing, resilience and hot tear strength, but SBR rubbers are more resistant to abrasion and weathering. These are used for car tyres, belting, shoe soles, flooring and electric insulation, etc.

3. Neoprenes(CR)

These rubbers are polymers of chloroprene. The basic raw material is butadiene.. These are vulcanised with metal oxides and cannot be vulcanised to hard rubber. They have outstanding resistance to ozone, weathering, a variety of chemicals, oils and flame. They have high freezing points and also high costs. Their uses include oil-resistance applications, hose, low-voltage insulations, adhesives, moulded articles and tank linings, etc.

4. Butyl Rubbers (IIR)

These rubbers contain isobutylene with small amounts of isoprene or butadiene. They have great impermeability to gases and have high resistance to aging, good resistance to oxidising agents. Vulcanisation with sulphur produces soft rubber. These are used for tyre, inner tube, adhesives, tank lining, cable and wire insulation, etc.

5. Nitrile Butadiene Rubbers (NBR)

These rubbers are copolymers of a crylonitrile and a diene, usually butadiene. They possess excellent oil, grease and solvent resistance, and good resistance to abrasion and aging. They are used for tank linings, conveyor belts and hose. Because of their resistance to cold, they are selected for use in aircraft design for flying at high altitudes.

The normal grades have quite good physical properties though slightly inferior to those of natural rubber and SBR. Nitrile rubber is relatively expensive and is used principally for sealing applications (gaskets) where its excellent resistance to oil products and its good temperature resistance (95°C) are essential.

6. Silicone Rubbers (SR)

Silicone rubbers are a linear condensation polymer based on a dimethyl silicon polymer. In these materials silicon and oxygen replace carbon in polymer chains. They have poor physical properties and are difficult to process. They are the most stable of all rubbers and are capable of remaining flexible from -55°C to +315°C. They are unaffected by ozone, and are resistant to hot oils and have excellent electrical properties. But their resistance to some oils and organic liquids is only moderate. This can be improved by replacing some of the hydrogen atoms by fluorine, but at a great increase in cost. Silicone rubbers are used for wire and cable insulation coatings, tubing, packaging and gaskets.

7. Polyisoprene Rubber (IR)

Poly-isoprene is a substitute for natural rubber. This rubber is made from isoprene by use of one of two catalysts: (i) lithium metal and its alkyl, and (ii) a mixture aluminium alkyl and titanium tetrachloride. The rubbers so produced are substantially equivalent to natural rubbers, but possess better tensile strength.

Biopolymers

The advancement of textile technology gave a new kind of product usable in human body.

Biopolymers that are to come in contact with blood and tissues of the body must not destroy cellular elements of blood, enzymes, proteins, produce toxic and allergic reactions, and deplete electrolytes present in the body. Biomaterials are materials that can be implanted in the body to

provide special prosthetic functions or used in diagnostic, surgical and therapeutic applications, without causing adverse effect on blood and other tissues.

Biomaterials made from a wide spectrum of polymers, having diverse properties, more similar to the body, have been made available during the past few decades. Their appeal and acceptability is mainly due to their versatility and the fact they can be tailor-made or modified at will to suit specific body functions. The most widely used polymer in medical applications is silicone rubber (polydimethyl siloxane) due to its desirable flexibility, inertness to body fluids, non-toxicity, easy sterilization, etc. The South India Textile Research Association (SITRA) at Coimbatore has developed bio polymer tubes to be used in Heart Surgery during its research. Another polymer is polyurethane, since it is a highly versatile system having enormous manoeuvrability in the choice of its parent monomers, reaction conditions, and physical characteristics.

Catalogue of exhibits

396) Name of the exhibit : Bio polymer tube

Acc. No. : BP 1/2003

Provenance : SITRA, Coimbatore District, Tamil Nadu (from M/S Lakshmi Mills)

Plastics

Plastics are synthetic polymers and are available in natural form as resins, lac, casein etc., They are also manufactured synthetically as polystyrene, Polyvinyl chloride (P.V.C.) polyacrylic etc. Plastics have high corrosion resistance, high dielectric strength, good toughness and have low electrical and thermal conductivities. There are two types of plastics: such as Thermoplastics and Thermosetting plastics.

Thermoplastics

Thermoplastics are the polymers which soften on the application of heat with or without pressure but they require cooling to set them to shape and hard. It can be re-softened and remoulded by the application of heat and pressure. Thermoplastics are comparatively softer and less strong. They cannot be used at high temperatures, as they will tend to soften under heat.

Thermoplastics are used to make Toys, electric insulation tapes, photographic films etc.

Catalogue of exhibits

- | | |
|---|---|
| 397) Name of the exhibit : Vaseline Box (small)
Acc. No. : PL 1/2003
Provenance : Chennai, Tamil Nadu | 404) Name of the exhibit : Ponds Powder Cap (Big – Pink colour)
Acc. No. : PL 8/2003
Provenance : Chennai, Tamil Nadu |
| 398) Name of the exhibit : Vaseline Box(medium)
Acc. No. : PL 2/2003
Provenance : Chennai, Tamil Nadu | 405) Name of the exhibit : Cap (Pink Colour)
Acc. No. : PL 9/2003
Provenance : Chennai, Tamil Nadu |
| 399) Name of the exhibit : Vaseline Box (big)
Acc. No. : PL 3/2003
Provenance : Chennai, Tamil Nadu | 406) Name of the exhibit : Cap (White Colour)
Acc. No. : PL 10/2003
Provenance : Chennai, Tamil Nadu |
| 400) Name of the exhibit : Ponds Powder Cap (Light Orange colour)
Acc. No. : PL 4/2003
Provenance : Chennai, Tamil Nadu | 407) Name of the exhibit : Toothbrush stick (White Colour)
Acc. No. : PL 11/2003
Provenance : Chennai, Tamil Nadu |
| 401) Name of the exhibit : Ponds Powder cap (Light Blue Colour)
Acc. No. : PL 5/2003
Provenance : Chennai, Tamil Nadu | 408) Name of the exhibit : Toothbrush stick (Orange Colour)
Acc. No. : PL 12/2003
Provenance : Chennai, Tamil Nadu |
| 402) Name of the exhibit : Ponds Powder Cap (Small – Violet colour)
Acc. No. : PL 6/2003
Provenance : Chennai, Tamil Nadu | 409) Name of the exhibit : Mixie Jar
Acc. No. : PL 13/2003
Provenance : Chennai, Tamil Nadu |
| 403) Name of the exhibit : Ponds Powder Cap (Big – Violet colour)
Acc. No. : PL 7/2003
Provenance : Chennai, Tamil Nadu | 410) Name of the exhibit : Small Cap (white colour)
Acc. No. : PL 14/2003
Provenance : Chennai, Tamil Nadu |

Thermosetting plastics

Thermosetting plastics are the polymers, which require heat and pressure to mould them into shape. These polymers get softened, when heated and can be given any shape. On further heating they undergo a permanent chemical change and set hard. Once done so, they cannot be softened again by the application of heat.

Thermosetting plastics are hard, rigid and stronger. They can be used at high temperature without damage.

Thermosetting plastics are used to make T.V. and Radio cabinets, telephone receivers, electric plugs etc.

ELECTRICITY

An overview

Human beings first knew electricity on seeing the lightening and thunder. In the 19th Century, it was harnessed for lighting and running machinery. We display some of the early products and photographs of how electricity was produced and the uses to which it was put. Tamil Nadu has hydropower, thermal power and nuclear power generation. Photographs of some of these generation stations are shown.

An elaboration

Hydro Power

In hydroelectric power stations, electricity is produced with the help of waterpower stored behind a dam. In hydro power stations water is passed through water jets in to the turbines and spins them round. The turbines are connected to generators, which are machines that generate or produce electricity when they spin. Each turbine with coupled generator makes up a turbo generator. The powerhouse of a dam contains several turbo generators. The generated electric power is then transmitted through transmitting sub stations. The first hydroelectric plant was installed in an old leather mill at Godalming in England in 1881 AD. The electricity produced there was used for street lighting. The first modern hydroelectric plant was installed at Dinorwic in Wales (England). In Tamil Nadu Pykara in Nilgris Dsitriect(1932) and Mettur (1934) in Salem District are the two pioneers dams with provision for producing Hydro Electric Power.

Thermal Power

Thermal Power Stations use steam turbines instead of water turbines to spin the electricity generators. In most thermal power stations steam is produced or raised in boilers heated by burning coal or oil. The steam produced in the boilers is channelled to the steam turbines at very high temperature (over 500°C) and at very high pressure (over 300 times atmospheric pressure). The steam turbine consists of a number of bladed wheels mounted on a shaft. This shaft is coupled to the electricity generator, which produce electric power. In Chennai Ennore and Basin Bridge have Thermal Power stations.

Electric power may be produced for utilisation purpose under two system, viz:

- i. Direct Current (D.C)
- ii. Alternating Current (A.C)

Direct Current

In direct current systems the flow of current is in one direction only i.e. uni-directional flow and the voltage is generated at a constant value. It cannot be increased or decreased to a desired voltage without involving costly equipments and hence D.C. system is not desirable for transmission and distribution purposes. The use of the direct current is found essential in electro-plating processes and speed control of motors.

Alternating Current

An electric current which first flows in one direction and then in the other in the periodic manner, such that the time of each alternation being constant, is known as alternating current. In this system voltage can be increased or decreased to a desired voltage without involving much cost and hence it is desirable for transmission and distribution purpose.

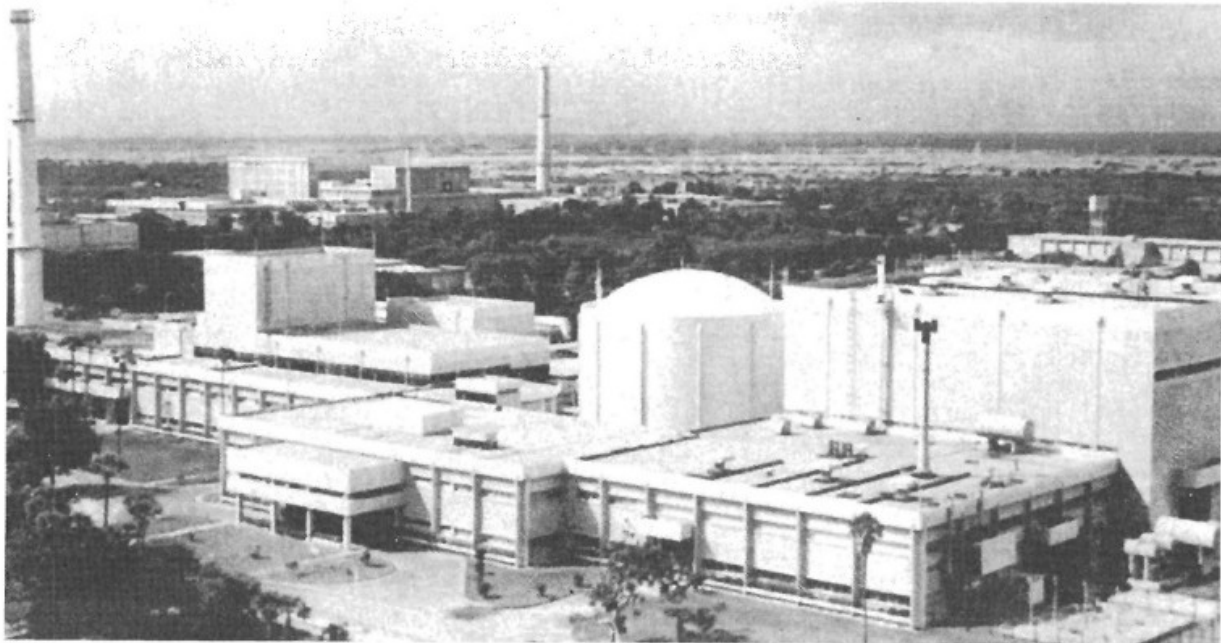
Atomic Power Stations

In Atomic Power Stations nuclear reactors are used to produce the heat needed to turn water into steam and channelled to the steam turbines. The main part of a nuclear power station is the reactor. Inside the reactor there are cans containing pellets of uranium. Uranium is a metal whose atoms can be made to split - "nuclear fission" easily. When the uranium atoms split, a lot of energy is given out as heat. A gas or liquid passes through the reactor and carries away the heat.

The hot gas or liquid passes through pipes in a heat exchanger, which contains water. The water is heated to boiling point and turns into steam. The steam is then piped into ordinary steam turbines and spins them round. The turbines are connected to generators, which produce electricity. Britain, the United States, Russia, France and several other developed countries get quite a lot of electricity from nuclear power stations.

Indira Gandhi Atomic Power Station at Kalpakkam

The discovery in 1939 of the fission of uranium atoms by neutrons was the beginning of far reaching developments, leading to the harnessing of nuclear energy for electricity generation. U-235 is the only naturally occurring material, which can sustain a fission chain reaction in a nuclear reactor, and is said to be 'fissile'. This isotope has an abundance of just 0.71% in natural uranium, the rest being U-238. Other fissile materials like plutonium or U-233 are man-made. The number of neutrons emitted during fission depends on the fissile atom as well as the energy of the neutron inducing the fission. Of the emitted neutrons, one is required to maintain the fission chain reaction, some are lost by leakage from the reactor, and some are captured by the fission products, core structural material and the coolant. The remaining neutrons can be captured in



U-238 or thorium to transmute them respectively into plutonium or U-233. U-238 and thorium are termed 'fertile' (the term denotes the isotope in a nuclear reactor which can be converted by the

capture of the neutron into a fissile(capable of nuclear fission) isotope) materials. When the fissile atoms created in this manner exceed fissile atoms utilised for production of energy, the reactor is said to be a breeder reactor and the process can be termed as 'breeding of fuel'.

The **Pressurised Heavy Water reactor (PHWR)** has been chosen as the reactor type to establish the initial nuclear power base in India. In this reactor system heavy water is used as 'moderator' to reduce the speed of fission neutrons to low values before causing further fissions and continuing the chain reaction. The main advantage of the PHWR is that it can be fuelled with natural uranium.

The stage has now been set for the effective utilisation of plutonium in **Fast breeder Reactors (FBRs)**, which will form the second stage of the Indian Nuclear Power Programme. FBRs provide the key to the full utilisation of the country's uranium resources and prepare the way for the long-term utilisation of the more abundant thorium resources.

The best developed type of FBR is the **Liquid Metal cooled Fast Breeder Reactor (LMFBR)** using liquid sodium as coolant to extract the heat from the reactor. The design of the LMFBR is in many ways different from that of the PHWR.

Considering the crucial role that FBRs are expected to play in India's future energy mosaic, the Department of Atomic Energy has established the **Indira Gandhi Centre for Atomic Research** at Kalpakkam, 60 km south of Madras, for the indigenous development of LMFBR technology. The main facility at this Centre is the **Fast Breeder Test Reactor (FBTR)** with a capacity of 40 MWt. The purpose of constructing FBTR is to use it as an irradiation facility for the development of the FBR fuel cycle, and to gain experience in the design, construction and operation of LMFBRs.

FBTR has been designed and constructed with French collaboration and is similar to the RAPSODIE reactor in France. However, a number of design modifications have been incorporated in FBTR including the addition of sodium heated steam generators and a turbo-generator to produce electricity (Source: Fast Breeder Test Reactor - a publication of Indira Gandhi Centre for Atomic Research, Kalpakkam) .

Communications and Electronics

An overview

We also have the models of the telegraph, telephone and the radio, which transformed communication and enabled the people in various parts of the world to keep in touch with each other instantaneously. This was a great revolution, which made this world a very small one. This revolution created the electronics industry. We show the development of communications by telegraph and telephone and display some cute miniaturised electronic products, which show how we have advanced from the valves to the transistor to the integrated circuits to the latest micro miniature circuits. We also show an early model computer, which created the Information Revolution.

An elaboration

Electronics

Electronics is the study of the behaviour of electrons (tiny particles and parts of atoms) and the ways of controlling them to do useful jobs. Electronics are more important in information technology and communications. Nearly all the equipments we use in our daily life, from radios, calculators and remote controls to telephones, computers and cars contain electronic circuits, which make their work.

The study of electronics began in the closing years of the nineteen century AD. In the early 20th century it was successfully used in the development of radio communication. Thermionic valves are the first electronic devices. Thermionic valves contain diode and triode. The diode valve allows current to flow through it one-way but not the other way and triode could be used to control a much larger current with small current. The parts of thermionic valves, some of which glowed red hot, have to be enclosed in a vacuum glass tube. In the middle of the twentieth century AD, semiconductor devices replaced valves. Semiconductors act both as a good conductor of electricity and an insulator.

Of the many different electronic components the most common ones are resistors, capacitors, diodes and transistors, resistors restricts the flow of current in a circuit. Capacitors store electric charge. Current can flow in to them until they are full and out of them until they are empty. Diode, as in the case of Thermionic valves, allows current to flow one way but not the other way. Transistor can be used as a switch or an amplifier. It has three connections. The current

flowing between two connections is controlled by a tiny current flowing in to the third connection. The electronic circuit contains components linked together by wires. Around which electric current passes. By combining different components and connecting them in different ways, different electronic circuits are made. In an electronic circuit, the components of the circuit themselves control the current. The components of an electronic circuit are soldered on to a circuit board by their legs.

Circuits that require a large number of components would be very big. This hurdle has been overcome by the introduction of integrated circuits or microchips. The components of integrated circuits are microscopically small and they are connected with a wafer of semiconductor material, which is normally silicon. For this reason integrated circuits are called as silicon chips (D.K. Visual Encyclopaedia, 1999). Application of Computers in this field brought in a tremendous revolution in Information Technology.

Catalogue of exhibits

- | | |
|---|---|
| 411) Name of the exhibit: Thermionic Valve
Acc. No. : EL 1/2003
Provenance : Chennai, Tamil Nadu | 416) Name of the exhibit: PCB Diagnostic Tester
Acc. No. : EL 6/2003
Provenance : Chennai, Tamil Nadu |
| 412) Name of the exhibit: Thermionic Valve
Acc. No. : EL 2/2003
Provenance : Chennai, Tamil Nadu | 417) Name of the exhibit: Digital Spring Balance
Acc. No. : EL 7/2003
Provenance : Chennai, Tamil Nadu |
| 413) Name of the exhibit: Resistors
Acc. No. : EL 3/2003
Provenance : Chennai, Tamil Nadu | 418) Name of the exhibit: SMPS (Switch Mode Power Supply) Transformer
Acc. No. : EL 8/2003
Provenance : Chennai, Tamil Nadu |
| 414) Name of the exhibit: Printed Circuit Board (PCB)
Acc. No. : EL 4/2003
Provenance : Chennai, Tamil Nadu | 419) Name of the exhibit: Deflection Yoke
Acc. No. : EL 9/2003
Provenance : Chennai, Tamil Nadu |
| 415) Name of the exhibit: Circuit Tracer Cable
Acc. No. : EL 5/2003
Provenance : Chennai, Tamil Nadu | 420) Name of the exhibit: Fly Back Transformer
Acc. No. : EL 10/2003
Provenance : Chennai, Tamil Nadu |

TELECOMMUNICATIONS

Telegraph and Telephones

The first telecommunication device was the telegraph. Messages travelled along wires from a sending device to a receiving device as pulses of electricity, using some sort of code that both the sender and receiver understood. Practical telegraph systems were developed in the first half of the nineteenth century and were first used for railway signalling. The major step in the development of telecommunications was the invention of the telephone by Alexander Graham Bell. When the telephone was invented, there was no telephone network to link telephones in different places, but one soon grew up. All the telephone lines in an area meet at a telephone exchange, where they can be connected to one another, or to a line to another area's exchange. The first exchange, opened in 1878 AD in Connecticut, USA, had just 21 lines. Like all early exchanges, it was operated by hand. A subscriber had to tell the operator which line the person wanted to be connected to. The automatic exchange, which allowed people to dial numbers, was invented in the USA by Almon Strowger and started working in 1897.

In 1881, the first Telephone Exchange in Madras was opened. It was situated in a building in Blackers Road, opposite to what is at present the "Bata Shoe Company". The number of subscribers is not definitely known, but must have been small, because by 1910 the number of subscribers had reached 350 only. This is not surprising because, between 1881 and 1890 very few cities even in Europe had telephones.

The first Telephone Switch Board was of the old "Magneto" type. Early in the 20th century, in 1900 the Telephone Exchange was shifted to Errabalu Chetty Street and a later pattern Switch Board was introduced. It is really from 1890 onwards that the development of communications in Madras really jumps ahead, although the name of M/S. Basil Cochran is associated with the development of communications in Madras. (Chapman, H.H., 1939).

Radio

The word "radio" means communicating with radio waves, which are part of the electromagnetic spectrum. Radio has a huge range of applications. It is used in the telephone network for mobile telephones and links in the network, for broadcasting, for two-way radio communications as used by the emergency services, and for remote control of machines. "Radio" also means the media of radio, in which music and speech from radio stations are transmitted by radio waves and are picked up by radio receivers.

The German physicist Heinrich Hertz confirmed the existence of radio waves in 1888 AD. However the first long-distance radio transmissions was made by the Italian Guglielmo Marconi in 1896 AD. In 1901 AD, he transmitted the Morse code across the Atlantic, Two-way radio communications using Morse code began in the early twentieth century and radio broadcasting began in the 1920s.



On their own, radio waves do not carry any information. To make an electrical signal, such as one representing sound, into a radio signal, the electrical signal is used to shape another signal, called the carrier wave. The shaped carrier signal is sent to a transmitter, where it creates radio waves.

The shaping process is called modulation. So that radio signals from different transmitters do not interfere with each other, they are sent using carrier waves with different frequencies. The whole family of radio waves is divided into sections called wavebands. Each waveband is reserved for a different form of communication. A radio receiver detects radio waves of the right frequency and demodulates them to get back the original electrical signal.

Advent of Radio to Madras

The first systematic broadcast programme service in the country was organised in Madras in 1924 AD through the initiative of C.V. Krishnaswami Chetty, the Electrical Engineer of the Corporation of Madras.

Early in 1924, representatives of the Marconi Company of England toured the length and breadth of India demonstrating their wireless sets and encouraging interest in radio broadcasting.

In Madras, they gave their demonstration in April 1924. As a result of these demonstrations, many interested in radio decided to form a Radio Club in the city, and at a meeting convened at Rippon Building, home of the Corporation of Madras. The Madras Presidency Radio Club came into being on May 16, 1924, the first of the radio clubs in India. The Commissioner of the Corporation, G.T. Boag, I.C.S. took a keen interest in the formation of the Club. C.V. Krishnaswami Chetty, as one who knew radio engineering, was the spirit behind the Club.

The Club began broadcasting programmes on July 31, 1924, the day the Madras Presidency Radio Club was officially inaugurated, with the Governor, Viscount Goschen, as its Patron. In October 1927, the Madras Presidency radio Club was wound up because of financial difficulties. Madras was left without a radio station as the Indian Broadcasting Company was not able to start more stations due to lack of funds, since the number of radio licences in force was only 3,594.

At the time of the closing down of the Madras radio club, the transmitting set used by it was presented to the Corporation of Madras on condition that it organised a broadcasting service in the city. Municipal bodies in England had set an example by undertaking such broadcasts and it was felt that Madras should do likewise.

The Corporation's application for a licence to broadcast got bogged down in red tape with the Government of India. Sanction came nearly two years later, in May 1929.

Krishnaswamy Chetty was in charge of the Corporation Radio and got down to making the necessary arrangements, such as constructing a fairly soundproof studio and other such work. The studios of the Corporation Radio was located in Rippon Buildings itself and the transmitter mast was erected on top of the building. After test broadcasts had been made, the Corporation Radio went on the air on April 1, 1930. It functioned for 8 years and 5½ months and closed down only when All India Radio started its Madras Station on June 16, 1938. Now this obsolete transmitter is housed in the Children's Museum of the Government Museum, Chennai for public viewing.

The *Philco* radio set displayed in the gallery is believed to have been used by His Excellency, Netaji Subash Chandra Bose in his residence at Singapore Palace in 1945. This radio set was given as a gift to this Museum by Thiru A.K.G. Ramaswamy on 16.6.1968 (Museum Records).

Catalogue of exhibits

421) Name of the exhibit: Philco Radio

Acc. No. : TC 1 /2003

Provenance : Singapore

User: Netaji Subash Chandra Bose in 1945

TRANSPORT

An overview

Transport starts with the invention of the wheel, which along with fire changed the entire history of the world. They gave the human race a huge edge over animals. We show the potter's wheel, then how it became a bullock cart and then a chariot drawn by horses. This continued for more than 3000 years, till in the 19th Century the railways brought in steam locomotion guided by rails.

At the entry to the gallery, we show the foundation of 19th Century industrialisation, the railways. This changed the entire mode of transport. Large quantities of goods and large numbers of people and troops could move from one part of the country to another very quickly. We have depicted the early steam engine and the progress of technology till the development of the diesel engine and the electric engine. We have shown some models and photographs.

Roads were a method of travel i.e land travel from the pre-historic era. We have seen the progress up to horse drawn chariots above. With the invention of the bi-cycle and the Internal Combustion Engine, land transport got transformed. Bicycles were first imported from England and then locally manufactured. They remain a cheap mode of transport for the common man even today. They are also used to transport goods by vendors - the quantity that can be loaded on the back carrier. The motorcar, the bus and lorry became modes of fast transport of people and goods. They also forced the laying of macadamised roads of good quality. Models and photographs of these are shown in the Gallery.

Waterways like rivers and then the sea and ocean became a mode of travel to distant lands from the early historic era. Small boats for going in rivers were first made. Then wind-powered ships of increasing size with large sails were built. In the mid 19th Century AD, steam powered ships were made. This revolutionised sea transport. Then came diesel engines, driven by fossil fuels. These were used to power ships. Even nuclear powered ships are there, but we show models and photographs of ships excluding nuclear powered ones.

Man had always thought of flying like birds. The epic Ramayana, which is several thousand years old, talks of aerial flight and *vimanas* or flying machines. This was translated into reality in



the early 20th Century. We show models and photographs of aeroplanes, which transport both people and goods now, mostly below the speed of sound (sub-sonic). We also show some rockets, which is the next stage of travel at multiple times the speed of sound.

An elaboration

Transportation

The development of transportation through land, water and air brought bigger areas of transactions and led to large-scale trade. The invention of wheel and use of animal power by the primitive people widened their sphere of transactions. People began to use carts and chariots pulled by horses, oxen or other large animals till 18th century AD. The first self-propelled vehicle was a clumsy steam-powered carriage designed to pull artillery guns was built by Frenchman Nicolas Cugnot in 1769 AD. Steam-powered vehicles called traction engines took the place of horses on European farms from the 1850s. Cars driven by small steam engines were popular in the USA in the 1890s.

Madras Road System

With the British occupation in 1639 AD and their permission to build a Fort at Madras, the need for Military Roads became essential and these Military Roads naturally came under the Military Engineering Department. But the maintenance of such roads depended upon their military significance. As the British occupation extended, certain Military Roads, being of no further use went into disrepair and others were extended. It was not till the year 1858, more than 200 years after the founding of Madras that Roads became a subject of serious consideration. At the commencement of British Rule, the responsibility for Roads came under the *Maramut* (Urdu for repairs) Department, but the date of establishment of this Department is not clear. The *Maramut* Department worked through the District Collectors and was in charge of all irrigation work, civil buildings, and roads. Though the Collectors were responsible, they did not receive professional aid of any kind. Later on, Engineering Officers were appointed to assist Collectors and received a designation of "Superintendent of Tank Repairs".

In 1825 AD, the entire *Maramut* Department was placed under the Board of Revenue and in 1836 the Chief Engineer received a seat at the Board to look after public works interests. The Public Works Department was born by the appointment of a Public Works Secretary to the Board of Revenue.

"The Great Indian Trigonometrically Survey", consisting of chains of triangles, was commenced about the year 1800 AD. The original base line on which all these millions of triangles were based was a straight line drawn roughly along Mount Road, between Madras and St. Thomas Mount. This first base line is approximately seven miles long. The first survey of India, therefore, started in Madras, and it can be assumed that the subsequent maps provided excellent data for Generals for the development of a road system from Madras into the interior for military purposes.

Governor's Coach at The Government Museum, Chennai

Two State Carriages were manufactured by Messrs. SIMPSON & Co, Madras (circa 1913 AD) at the instance of the Government of Madras for the use of the Governor of Madras on ceremonial occasions. The coach displayed in the Contemporary Art Gallery was presented to the Government Museum, Chennai by the Comptroller of the Household, Governor's Office (Raj Bhavan), Guindy, Chennai in 1964. This four-wheeled, four-seater coach was used by the Governors of the erstwhile British Government for ceremonial functions. The State emblem of the Government of Madras (present Tamil Nadu) (coat of Arms) is painted on both the sides on the doors of the coach. A Temple tower (*Gopuram* of the *Andal* and *Vatapatrasayi* temple, *Srivilliputhur*) with the three lion Asokan emblem of the Government of India is shown, but the legend '*Satyamēva Jayatē*' is not seen. The British Coat of Arms might have been originally painted on it. Two oil lamps (European model) are fitted on the front portion of the coach. On the polished metal, housing the lamp wick, the words 'Simpson & Co Ltd., Madras' are inscribed on each lamp. The rear side of the Coach is provided with seating arrangements for an attendant. Each rear wooden wheel has 14 wooden spokes, while the front wheels have 12 spokes each. For smooth riding, white walled black solid rubber tyres are fitted on the outer rim of each wheel. On the hub of the wheel, the manufacturer's name and serial number are embossed as SIMPSON & Co, Madras - (Sl. No. 9766). The measurement of the coach is Length- 4.30 metres; Breadth-1.92 metres and Height-1.94 metres. It has been fitted with four leaf springs on the back axle and another four, on the front axle completely insulating the seating box from any jerks. It has a steering wheel in front. All these are quite sophisticated for their time. This company was almost a monopoly supplier of coaches to Maharajahs and Governors and other dignitaries. Similar type of coaches are on display at the Historical Museum, Hill Palace, Tirupunitura, Kerala, housing the memorabilia of the Maharajahs of Cochin.

The coach, presented to the Museum, was in a dilapidated condition and now it has been refurbished and displayed in the Gallery on the Progress of Industries and Handicrafts of Tamil Nadu. Leather upholstery in navy blue colour was seen and it has been restored similarly. The colour of the body is also painted navy blue (original colour). The body is made of wood. (Photos, page no. 154).

The then Governor of composite Madras State, the Maharaja of Bhavnagar used this coach for his State drives till 1952. During the celebrations of Independence Day of the year 1956 held in Chennai, a similar coach (probably the second coach) was used by the President Dr. Rajendra Prasad during his State drive to the Island Grounds to witness the military parade. (Photos -(reproduced from *The Weekly Mail*, 25th April, 1953 and *The Hindu*, 19th August, 1956)-page nos. 131,132). This was the only occasion when this function was held outside Delhi with the President attending it.

Even in 1953, an interesting report was published about this Coach in the *Weekly Mail* {(Saturday the 25th April) (now ceased publication)} which expressed concern about preserving this historic coach. A copy of the report is reproduced here.

THE OLD ORDER GOES

Madras State carriage to be sold

MOTORS TO BE USED IN FUTURE

(By a Staff Reporter) (From The Weekly Mail - 25-04-1953)

CITIZENS of Madras will not again witness the picturesque state drives which Viceroys and Governors made, in a horse-drawn carriage, escorted by mounted sowars. One more link with the pomp, dignity and splendour of the head of the State is to disappear.

The Madras State carriage, the only one remaining, which was used by the Governor for state drives, is to be sold by public auction. The Government has, decided to use in future an open motor tourer for purpose of state drives.

Citizens, particularly the older ones who have vivid recollections of such state drives in the past, might regret the decision that there will be no more state drives in horse-drawn carriage. And who will not share the regret when they pause and ponder the picturesqueness of such drives, which were really 'stately'.

The head of the State travelling even in an open motor car will not produce a tithe of the effect, or strike the imagination and fancy as a drive in a horse drawn carriage with all its rich and colourful paraphernalia.

New times

New times bring new manners, and many old and hoary customs are replaced by new ones not because, as the Poet said, of any corrupting influence, but because it may not stand the test of utility, the current deity.

Many a time-honoured, and traditional practice, with its intangible worth and appeal to the emotions and imagination is sacrificed at the altar of utility, or economy, or a pseudo-rational-cum-materialistic outlook which has no place for anything that caters to sentiment. And the state carriage is, perhaps, one

more victim, for in the absence of any pronouncement one can only guess the reason behind the decision.

The state carriage, is either considered out-moded, or too costly. Belated tears, I hear some whispering. The sentence on the state carriage was really passed—though the execution has been delayed—when that equally memorable institution, the Bodyguard, was abolished in the wake of independence. Much of the stately and picturesque effect of the drive of the head of the State in a horse-drawn carriage was contributed by the mounted sowars of the Bodyguard in their colourful uniform. The same effect could not be produced by the mounted khaki-clad sowars of the City Police taking more place, though even this would be more impressive than a drive in an open tourer car escorted by motor cycle patrols.

Last drives

When the Governor's Bodyguard was abolished in 1948 the state carriage was handed over to the custody of the City Mounted Police. Since then state drives in carriage have been a rarity. The last one, was by the Maharajah of Bhavnagar about 1951 for the Park Fair Exhibition. The present Governor has not had such a state drive in the carriage. Two of the four horses were destroyed about two years ago as they had become too old, and the other two have also become very infirm, and are to be destroyed.

A proposal to buy six horses for the carriage it is learned was approved last year and the necessary amount was sanctioned. But, it is stated, horses of the required type were not easily available in India, and would have to have been imported only from Australia and the cost, particularly when only a small number had to be got, was very high.

Meanwhile the Government, perhaps on grounds of economy, or because it was thought that this was an outmoded custom, cancelled the previous order, and decided to exchange the carriage for an open motor tourer. This might also save high maintenance charges of the horses.

And uniforms

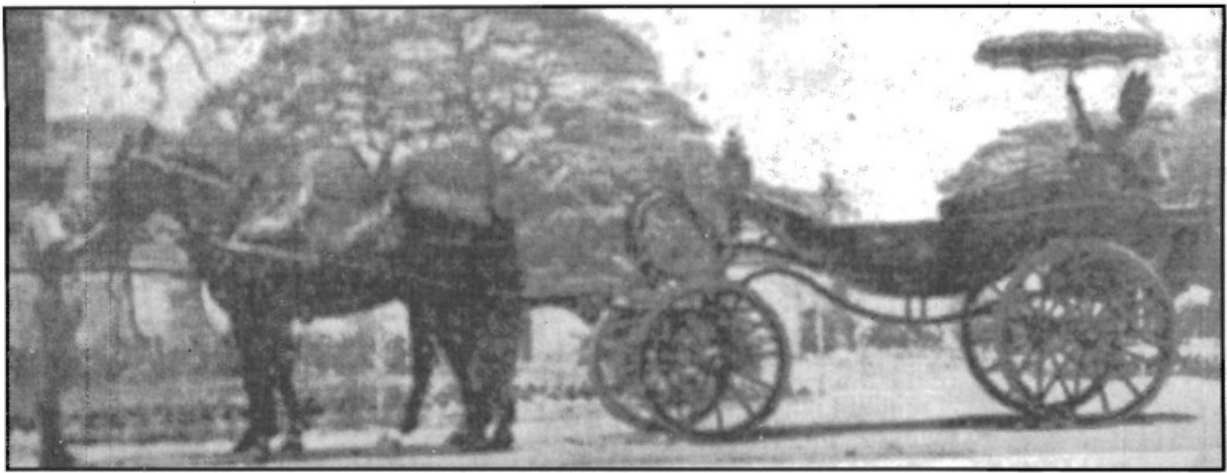
The carriage to be auctioned was built by the firm of Simpson and Company which were famous in the past for making coaches and carriages for the more leisurely days of the past.

And not only is the State carriage to be put under the auctioneer's hammer, but all the paraphernalia associated with it, including the gold and silver umbrella, and silver fan which ladies of Governors gently wielded. There are the white topped, black boots and caps of the postilions, and the harness for the horses. Even the trumpet which heralded the approach of the State carriage is to be sold.

Perhaps some sentimental philanthropist will come forward to buy all and present them to the museum for future generations to admire.



One of the last state drives, by the Governor, the Maharaja of Bhavnagar, who used the carriage on several occasions, but without the bodyguard escort or gaily dressed postilions.



State Drive carriage as it is today (1953) ready to be auctioned.



In a former day, a state drive in 1940 by the then Governor Lord Erskine with the postilions in full uniform, white topped boots and red jacket, and jockey-type cap, and followed by the Bodyguard.



This year (1956) Independence Day Celebrations in Madras city were rendered memorable by the presence of the President, Dr. Rajendra Prasad. He drove in a state coach to the Island Grounds, where over lakh of people witnessed the military parade.

(courtesy - The Hindu)

Catalogue of exhibits

422) Name of the exhibit: Bullock Cart (Model)

Acc. No. : Tr 22/2003

Provenance : Chennai, Tamil Nadu

423) Name of the exhibit: Coach

Acc. No. : Tr 23/2003

Provenance : Rajbhavan, Chennai, Tamil Nadu

Cars and Trams

The age of the car really started with the development of the internal combustion engine. This development began in the 1850s, but it was not until the 1880s that small, lightweight, petrol-driven engines were perfected, first of all by Gottlieb Daimler in Germany. The first petrol-driven car was built by German engineer Karl Benz in 1885 AD. The job of the internal combustion engine is to convert the energy stored in its fuel into movement. Inside the heavy engine block are cylinders (normally four in a car engine). Pistons fit snugly inside the cylinders. When the engine is running, the pistons move up and down, turning a crankshaft (which turns the wheels) via connecting rods.

Benz and Daimler started selling cars in the late 1890s. In 1891 the first car with a front engine and rear-wheel drive appeared. Early cars were tricky to operate, slow and hand-built, which made them expensive. In 1908 motoring was opened up to ordinary people with the introduction in the USA of the Model-T Ford. This small car was built on a production line, making it cheap to make and so cheap to buy.

In 1894, when the first motor car visited Madras city, barely ten years had passed by since the "internal combustion discovery of the engine" by Daimler. This engine, which was to revolutionise human life and human transport beyond recognition in the coming decades - we owe not only road transport but also the aeroplane and modern ocean-going transport to this major discovery-had been fitted to a *landau lie* vehicle and the petrol-driven 'automobile age' was born.

Madras hosted its first motor car to remain in the city a few years after the visiting showpiece was seen on Mount Road in 1894. The credit for brining the city's first permanent car goes to A.J. Yorke, a Director of Parry & Co., who while on 'home leave' in England bought it and brought it with him.

Yorke lived in Adyar and every day his motorcar, a wonder to the city's inhabitants, went in the morning from Adyar through Mylapore, San Thome and the Beach Road (Marina) to Parry's Corner. George Oakes, Addison and Simpsons were some of the famous purveyors of motorcars to the Madras public (Padmanabhan, R.A, 2001).

Messrs. Simpson and Co., Ltd, played a large part in the development of the early Motorcars

and buses. Although it was many years before Madras had a properly organised Bus service, Messrs. Simpson and Co. Ltd., have some interesting catalogues of buses dating back prior to 1910. The type of buses illustrated is essentially similar to the open type of bus. From 1910 onwards there was seen a steady increase in the number of buses running and owners were badly organised and the buses left much to be desired in speed, safety and comfort. The first attempt at organising the bus transport was undertaken by the Madras Electric Tramways (1904) Ltd., who in the years 1925-27 operated a fleet of 50 Motor Buses. This scheme was abandoned in 1928 owing to the uneconomical competition offered by the unorganised bus owners, and Madras reverted to its unsatisfactory bus system until about 1933 (Chapman, H.H, 1939). By the second half of 1930s there was a large number of miles of really first-class roads and these were being annually improved. The Bus Services were nationalised in the late 1960s. Many private companies are operating modern Saloon Buses (omni buses) for tourists comparable with any other country in the world .

M/S Ashok Leyland are a major lorry and bus chassis manufacturer based at Ennore who started in the 1950s. M/S Standard Motor Products of India made the Triumph car (called Herald in India) and Standard cars from 1950s till 1980s. The Royal Enfield Co. manufactures motor cycles from 1950s till now. The Amalgamations Group and the TVS group and other small scale industries have made Chennai the automobile component manufacturing capital of India. Recently, M/S Ford and M/S Hyundai are making world class cars.

Catalogue of exhibits

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| <p>424) Name of the exhibit: Cargo Truck Model (Blue colour)
 Acc. No. : Tr 1/2003
 Provenance : Chennai, Tamil Nadu</p> | <p>427) Name of the exhibit: Mahendra Jeep Model
 MM 540/550 (Green and White colour)
 Acc. No. : Tr 4/2003
 Provenance : Chennai, Tamil Nadu</p> |
| <p>425) Name of the exhibit: Cargo Truck Model (Yellow colour)
 Acc. No. : Tr 2/2003
 Provenance : Chennai, Tamil Nadu</p> | <p>428) Name of the exhibit: Metropolitan City Bus
 Model (Small)
 Acc. No. : Tr 5/2003
 Provenance : Chennai, Tamil Nadu</p> |
| <p>426) Name of the exhibit: Mahendra Jeep Model
 MM 540/550 (Blue and White colour)
 Acc. No. : Tr 3/2003
 Provenance : Chennai, Tamil Nadu</p> | <p>429) Name of the exhibit: Metropolitan City Bus Model (Big)
 Acc. No. : Tr 6/2003
 Provenance : Chennai, Tamil Nadu</p> |

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|---|--|
| <p>430) Name of the exhibit: TAFE Tractor Model 45 D
 Acc. No. : Tr 7/2003
 Provenance : Chennai, Tamil Nadu</p> | <p>433) Name of the exhibit: Massey –Ferguson Tractor 35
 (Model)
 Acc. No. : Tr 10/2003
 Provenance : Chennai, Tamil Nadu</p> |
| <p>431) Name of the exhibit: Massey –Ferguson Tractor 95
 (Model)
 Acc. No. : Tr 8/2003
 Provenance : Chennai, Tamil Nadu</p> | <p>434) Name of the exhibit: Mahendra Tractor B 275
 (Model)
 Acc. No. : Tr 11/2003
 Provenance : Chennai, Tamil Nadu</p> |
| <p>432) Name of the exhibit: HMT Tractor 3522 EDI Model
 Acc. No. : Tr 9/2003
 Provenance : Chennai, Tamil Nadu</p> | |

Trams

In 1892 AD, the Madras Tramways Company was floated and sanction was given to Messrs. Hutchinson & Co., Ltd., London, with a capital of £100,000 to start a Tramway system. Three years later (1895), the first Tramway Section was completed and open for the use of the public. The Madras Electric Tramways were opened in May, 1895, fully six years before Electric Tram Cars were running anywhere else in India and even in London and other large cities in England, another example of Madras being ahead in its development.

In 1900, the original Tramway Company was obliged to sell the undertaking, as the capital was inadequate. The purchasers, "The Electric Construction Co., Ltd.," then operated the Tramways in Madras for a period of four years. It was at this time that the first Motorcars were seen on the roads in Madras. The first one did not have a very successful life. It was put on the road in 1894 and was driven some distance down Mount Road.

RAILWAYS

Steam Engines

An Engine is a machine that converts the energy stored in fuel into energy for operating other machines. In a steam engine, burning fuel heats water in a boiler, turning it to steam. The pressurized steam is used to operate the moving parts of the engine. The first steam-powered machine was built in 1698 by English Engineer Thomas Savery. It was designed to pump water from flooded mines, but was never actually used.

In 1712 another English Engineer, Thomas Newcomen, invented a steam engine for pumping mine water. It was more suited for coalmines, where there was an endless supply of coal. Scottish Engineer James Watt built his own steam engine in the 1770s, which became popular for powering industrial machinery, such as spinning and weaving machines also. James Watt's Steam engine included many improvements over Thomas Newcomen's. It had a separate cylinder where the steam was condensed, allowing the main cylinder to remain hot all the time. The piston was double acting, which means it was moved both up and down by steam.

Modern Trains

There are three types of modern locomotive - electric, diesel-electric and diesel. On an electric locomotive, the wheels are moved by electric motors (normally one for each pair of wheels). The electricity usually comes from overhead cables, but sometimes from an electrified third rail. On a diesel-electric locomotive, the wheels are also driven by electric motors, but the electricity comes from a generator driven by a powerful diesel engine. On a diesel locomotive, a diesel engine drives the wheels via a mechanical transmission.

South Indian Railways

A small rail line was introduced in India for the first time near the Chintadripet Bridge in the Madras Presidency in 1836 AD. It was driven by a Bullock Cart. The Cart was placed upon the rails loaded with stones, which was easily moved up a slightly inclined plane in one hand. It returned by its own weight to the place from which was first propelled (Bhandari R.R., 2000).

Railways was introduced to India in the year 1853 AD. Robert Stephenson (son of George Stephenson) who constructed the line between Bombay and Thane, was the pioneer who brought the transport revolution to India. Next came the Howrah to Hoogly section (23 miles) in 1854. The third section (65 miles) to be opened was in Madras from Royapuram to Wallajah Road in 1856.

The Madras Railway Company, which brought railway to Madras, commenced its operations with the opening of the Royapuram-Wallajah Road in 1856. The M.R.C. extended the line up to Kadalundi in 1861 and Calicut in 1888. The Jolarpet-Bangalore cantonment section opened in 1864, went upto Bangalore City in 1882. By 1862 the Railway extended up to Renigunta and the line was further extended in stages upto Raichur by 1871. From 1st January 1901, the Madras Railway Co.,

took over the East Coast State Railway, which had opened the line from Rajahmundry to Waltair and Bezwada to Kovvur in 1893.

Meanwhile, the Southern Mahratta Railway Company, working under a contract since 1882 with its headquarters at Dharwar, started with the opening of Hospet to Bellary and Gadag to Hotgi sections in 1884. The Southern Mahratta Railway constructed and worked most of the M.G. portion in addition to working for the West of India Portuguese Railway. The section in Goa terminating in Mormugao was opened for traffic in 1888. By the end of 1890, the Southern Mahratta Railway extended from Poona to Mysore (via-Bangalore) and from Bezwada to Mormugao.

On 1st January 1908, the Madras Railway Company and the Southern Mahratta Railway Company came together to form the Madras and the Southern Mahratta Railway Company.

The South Indian Railway

The "Great Southern of India Railway", opened its first line for traffic between Nagapatnam and Tanjore in 1861 and extended it up to Trichirappalli in March 1862. It was later linked to the Madras-Beyepore line via-Erode. On 1st July 1874, the Great Southern of India Railway amalgamated with the Carnatic Railway Company and formed a new South India Railway Company. The newly formed S.I.R. with its headquarters in Tiruchirappalli, progressed rapidly. By the end of 1880, the S.I.R. Company had constructed the line from Madras to Tuticorin, a distance of 444 miles with branch lines from Trichirappalli to Erode, Chingleput to Arakkonam, Tanjore to Negapatnam (Nagapattinam), Maniyachi to Tirunelveli and Villupuram to Gingee River Station (old name). The South Indian Railway was purchased by the State and handed over together with the Villupuram Guntakal State Railway to new company - the South Indian Railway Company Limited on 1st January 1891.

The South Indian Railway Company handed over to the Madras and Southern Mahratta Railway Company, the metre gauge lines from Katpadi to Dharmavaram and from Pakala to Gudur while retaining running powers over the broad gauge section from Madras to Bangalore.

Of the three Railways of South India the Madras and Southern Mahratta Railway covered both the states of Madras and Bombay and brought them together, in addition to serving as the artery between the North and South of India. The Mysore Railway filled a gap left by the Madras and Southern Mahratta Railway in the contact between Madras and Bombay states. The South Indian Railway brought the states of Madras and Travancore - Cochin together.

The Madras and Southern Mahratta Railway, South Indian Railway and the Mysore State Railway were merged together on 14th April 1951, to form the Southern Railway, the first zonal railway to be formed on the Indian Railway System.

Ooty Hill Railway

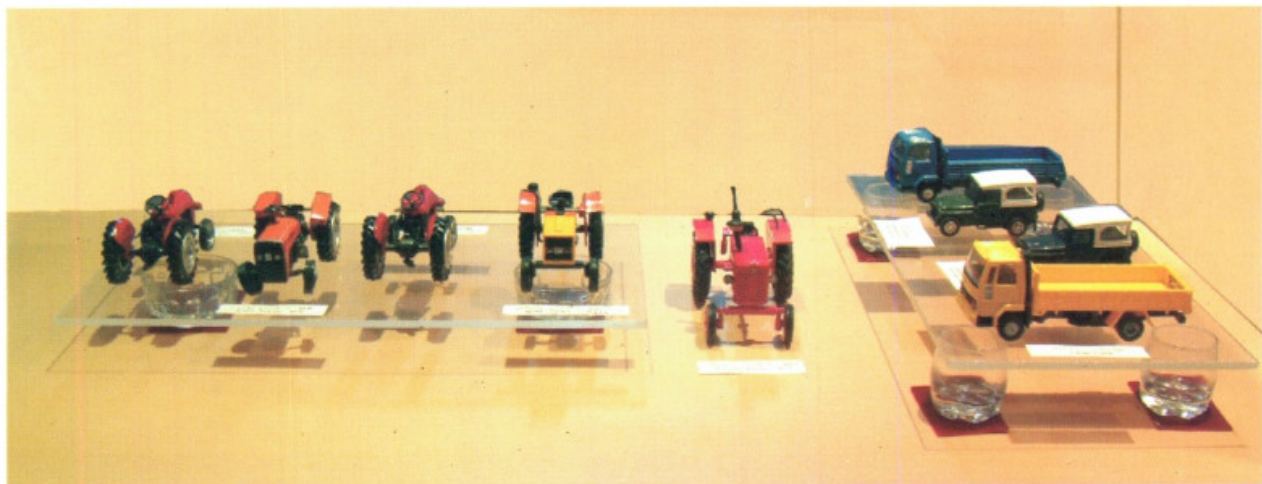
The Nilgiri Railway Company was registered on September 30, 1885 with nominal capital of Rs.2.5 million, but soon went into liquidation in April 1894. A new Company was formed in February 1896. The line from Mettupalayam to Coonoor was completed by the new Company and opened for traffic on June 15, 1899. But soon it sold the line to the Government for £235,000 on January 1, 1903. The extension to Ootacamund was constructed by the Government and opened for traffic in 1908. With effect from January 1, 1908, it was made over to the South Indian Railway Company as a part of Jalarpet (Jolarpet) - Mangalore section. After completion of Coonoor - Ootacamund line, it was also handed over to South Indian Railway for maintenance and operation. The principal contract of SIR was terminated on March 31, 1944, and the working including that of Nilgiri Railway was taken over by the Government of India. In April 14, 1951, Southern Railway was formed by Railway together both the SIR and Nilgiri Railway. However for its speciality NR is still referred as Nilgiri Railway.

Catalogue of exhibits

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|--|---|
| 435) Name of the exhibit: Model of the Nilgiri Mountain Rail (Engine) (X – 37385)
Acc. No. : Tr 12/2003 | 439) Name of the exhibit: <i>Rajadhani</i> Coach Model
Acc. No. : Tr 16/2003 |
| 436) Name of the exhibit: Model of the first Steam Engine (Rocket)
Acc. No. : Tr 13/2003 | 440) Name of the exhibit: Vee Type Diesel Locomotive Model
Acc. No. : Tr 17/2003 |
| 437) Name of the exhibit: Rail Engine Model (Steam)
Acc. No. : Tr 14/2003 | |
| 438) Name of the exhibit: Rail Engine Model (Diesel)
Acc. No. : Tr 15/2003 | |



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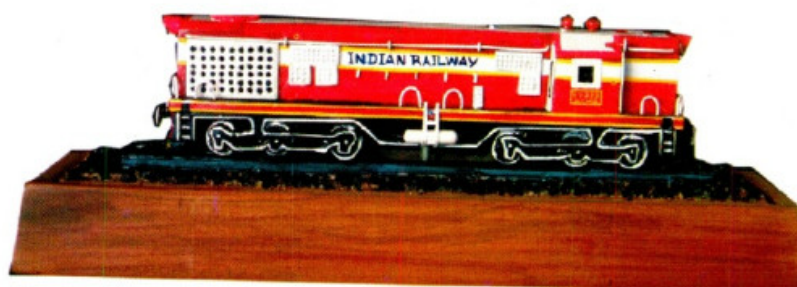
C

Road Transport Models

A. Sl. No. 422

B. Sl. No. 433, 430, 431, 432, 434

C. Sl. No. 424, 427, 426, 425



Railway Models

Sl. No. 435 - 438

Development of Railway Stations

Chennai Central and Egmore

The Central Station was opened for traffic on 7th April 1873 in Rayapuram. Initially, passenger train services to the north and southwest lines were handled at the station. However, increase in traffic demands forced the transfer of train services from Rayapuram to Central in 1907. Minor improvements were made to the station and yard since 1907. Remodelling of Madras Central commenced in the year 1932 to cope with the increased number of passengers as well as trains. Increase in length of platforms, provision of cover to the platforms and increase in the circulating area for passengers, construction of adequate waiting rooms, luggage rooms and booking office and construction of retiring rooms with modern sanitary equipment were the salient features of the remodelling work. In April 1951, 20 express/passenger trains were handled at Madras Central.

The process of remodelling continued in order to meet the requirements of the day. The suburban terminal at the Moore Market Complex, adjacent to the Central station, was opened for traffic on 17th October 1981. Distinct in style and structure, the Madras Egmore Station, completed in 1908, was in Mughal style - a rare phenomenon in the South India. The coat of arms of the South India Railway Company can be seen on the top of the Egmore Station and that of MSM Railway in the Park office complex.

Electric Train in Chennai

In India, the first electric train ran on 3rd February 1925, between Victoria Terminus and Kurla on the Central Railway. On the Southern front, the inauguration of the electrified suburban service of the South Indian Railway at the Madras Beach station on 2nd April 1931 was a landmark in the history of rail traffic in the Madras Presidency, as this was the first suburban railway in the country to be operated electrically on the metre gauge section. M/s. Robert White and partners, consulting engineers of the South Indian Railway Company, were the architects behind this development.

An all electric automatic signalling system was installed and three of the level crossing gates were motor operated and interlocked in the signalling system. The power supply was taken from the mains of the Madras Electric Supply Corporation. The supply was three-phase fifty cycles

at a pressure of 5000 volts. The three-phase supply was converted into a direct current supply and the conversion was effected by Mercury Arc Rectifiers, a type of plant, which was being used for the first time in India in connection with electric traction. The two substations at Egmore and Meenambakkam where the power supply was converted to 1500 volts DC and supplied to the overhead system, had many novel features of design. They were automatic but manual operation was possible in cases of emergency. The whole of the electrified system was controlled from a control room at Egmore substation.

With an astonishing power to pick up a speed of over 96 kmph in less than a minute, the electric multiple units lived up to their motto of "we carry a city to work". Besides reduction in journey time of passengers, the electrification of the suburban services actively encouraged movement to the suburbs by providing cheap, fast, clean and frequent services.

The entire train services were changed to 25 KV AC system in January 1965 with 43 EMUs, each EMU consisting of one motor and three trailer coaches. Being the heaviest section, the commuter traffic has reached a level of over four lakh passengers per day from a modest figure of 11,800 passengers in 1932-33 (Source: Indian Railways, 2001) .

WATERWAYS

Waterways like rivers and then the sea and ocean became a mode of travel to distant lands from the early historic era. Small boats for going in rivers were first made. Then wind-powered ships of increasing size with large sails were built. In the mid 19th century AD, steam powered ships were made. This revolutionised sea transport. Then came diesel engines, driven by fossil fuels. These were used to power ships. Even nuclear powered ships are there, but we show models and photographs of ships excluding nuclear powered ones.

Buckingham Canal

Mr. Cochrane excavated the first 20 km length of Buckingham Canal in 1806 AD, between Madras and Ennore. The canal was extended in 1857 up to Durgarajapuram in the North and upto Sadras in the South. In 1876, the canal was further extended up to Nellore in Andhra. The great famine of 1877 gave a thrust to this work and the canal was extended further upto Peddagangam in the North and to Marakkanam in the South. In 1882, the canal was named as Buckingham Canal in

honour of the then Governor of Madras. At that time it was one of the longest (417 km) man made canals of the world. This canal provided cheap water transport for firewood, salt, food grain and coal before the rapid growth of Buses and Rails till the late 1960s (Mohanakrishnan, 2001). It has become disused due to encroachments and landfills.

Tamil Navigators

In the early Christian era Tamil traders had a brisk sea trade. They built ships and ports. They ventured to go for east and Mediterranean countries for the trade. One of the most important sources of information of Indian ports and shipping during the first century AD is a book entitled the *Periplus of the Erythrean Sea*. The author of this work is believed to have been an Egyptian-Greek merchant engaged in trade who visited India in the second half of the first century AD. The *Periplus* is like a marine guidebook and gives a detailed account of harbours and articles of import and export on the route from the Red Sea and Persia Gulf to Malabar and Coromandel coasts.

As per the account of *Periplus* passing the *Cape Comari* (Comorin) one came to pearl fishery centres of *Colchoi* (Korkai) and *Argaru* (Uraiyur, ancient capital of the Chola country). The important marts in the eastern coast of Tamil Nadu were *Camara* (Kaveripattanam), *Poduca* (Pondicherry) and *Sopatma* (Marakanam). These were ports involved mostly in coastal traffic. Island of *Palaesimundu* (Ceylon) produced pearls, precious stones, muslin and tortoise shells.

Soon after the *Periplus of the Erythrean Sea*, Pliny (23-79 AD), a Roman scholar, described voyages to India and ports in Egypt, Arabia and India in his treatise 'National History' which was published in 73-77 AD. The Tamil literature of this period, the Sangam works like *Ettuthogai* and *Pattu Pattu* also speaks of prosperous ports and adventurous voyages of Tamils. Beautiful large ships of *Yavanas* (foreigners from the west) bringing gold were found at the important port of *Muchiris* near the mouth of the *Periar* on the West Coast (*Chera* country, present Kerala). The port of *Kaviripattinam* on the river Kaveri received heavily laden ships from the sea. Goods would be passed to the merchant's warehouses duly stamped by the emblem of the Chola kings after payment of the customs duties. Close by were the settlements of foreign merchants. On the Chola ports there were lighthouses built of brick and mortar, which exhibited lights at night to guide ships to ports.

Towards the end of the tenth century, the South Indian naval activities increased significantly

under the Chola Kings. Rajendra Chola who ruled from 1013 to 1040 AD conquered Ceylon, Laccadives, Maldives, Andaman and Nicobar Islands. He also defeated the King of *Kadaram*, now identified as *Prome* or *Pegu*. His conquests included the flourishing ports of *Takkolam* and *Matma* or *Martaban*. "The naval activities of the Chola emperors was not however, confined within the limits of the Bay of Bengal. They appear to have carried on their inter-course with countries of further east as far as China". The Chola kings often sent their missions to the courts of Chinese emperors. The objectives were mixed-political, cultural and trade. The ambassadors often had their own shares in the merchandise sent abroad.

Wasaf, a Muslim historian, who visited the Pandyan Empire, described the trade in an area called Ma'bar, which was the coast of South India from Quilon in the West coast to Nellore in the east coast. This area thrived on international trade. Trade with China in the east, and Iraq, Turkey and Europe on the west from Ma'bar was busy and prosperous.

During this period AD 1290s, Marco Polo, the renowned traveller, visited *Cail* or *Kayal* situated on the Tamraparni river. He described it as a great and noble city which was visited by ships laden with goods from the Persian Gulf and the Arabian coast. The ports of Malabar were centres of international trade.

In the fourteenth century AD, the Pandyas were ruling over a territory along the Coromandel coast in the east and from Quilon to Cape Comorin on the west coast. They had also control over Ceylon. The Gulf of Mannar was the territorial waters of the Pandya kings. The bed of this gulf was a prolific breeding ground for oysters and natural pearl which was a very rich product of the area. There was great demand of this pearl as jewel. In 1442 AD, Abdul Razzak, a Persian who visited India and the great Vijayanagar Empire of South India wrote that the Vijayanagara kingdom had in its control as many as 300 ports.

There were many ports in the Coromandel coast. The ports which developed at one time or other during the sixteenth-seventeenth centuries (from South to northward) were: *Tondi*, *Adirampatnam*, *Nagapatnam*, *Nagore*, *Karikal*, *Tranquebar*, *Tirumulaivasal*, *Porto Novo/Cuddalore*, *Tegenampatnam (Devanampattinam)*, *Pondichery*, *Sadraspattam Kovilam*, *Mylapore/ San Thome*, *Madras*, *Pulicat* and *Armagon*. The last was the first settlement of the British traders before they occupied St. George Fort. The place is a little to the north of Madras, may be Ennore or Pulicat).

A late comer in the maritime scene of India on the advent of Europeans East India Companies was the French. They had come to Malabar first in 1527, but it was not followed up by any serious attempt of establishing trade relationship in India. They started factories and settlements at *Masulipatnam, Pondicherry, Chandernagore, St. Thome, Mahe* and some other small places on the east coast. However *Pondicherry* became their main centre.

Catalogue of exhibits

441) Name of the exhibit: 'Flying Fish' – Cattamaran (Model) Acc. No. : Tr 20/2003 Provenance : Tamil Nadu	442) Name of the exhibit: Lugsail (Model) Acc. No. : Tr 21/2003 Provenance : Tamil Nadu
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A New Port City - Madras

The English East India Company developed Madras Port. In the early 17th century AD Madras was a small village with poor land where the *Elumbore* and the *Triplicane*, rivers converged to form a lagoon by the sea. Here the East India Company rented five square miles of land from the Nawab and the port now called Madras was created. "But it had no harbour, only an open roadstead. The water was shallow and ships had to anchor nearly a mile off shore. A sudden storm could have catastrophic results. Most of the cargoes had to be discharged into flat-bottomed country boats which could cross only after the rainy season. Nevertheless Madras flourished as a port. It attracted Indians and the foreigners alike. The town had three parts-the fortress, garrison and residence of the Governor called Fort St. George. In the town adjoining the fort lived the merchants from various countries like Armenians, Greeks, Dutch and Arabs. In the suburbs lived both the Hindus and the Muslims.

Soon Madras become one of the principal trading posts of East India Company. In 1639 a trading settlement started in Madras. In its early stage Madras was an open roadstead. The ocean going vessels would anchor off shore about 1 km from the beach. Small country lighters called *masula* boats would carry goods and passengers between the vessels and the shore. In 1796 a lighthouse was constructed to facilitate shipping. The lamps burned coconut oil. With the help of reflectors the light was visible up to a distance of 28 km.

Madras Port

Madras Port which because one of the Principal trading ports of English East India Company later, was started as a trading settlement in 1639 AD. In its early stage it was an open road street. The Ocean going ships would anchor off shore about 1 km from the beach. Small country lighters (booth with flat bottom) called *masula* boats would carry goods and passengers between the ships and shore. In 1796 AD, a lighthouse was erected and the lamps therein burned coconut oil, with the help of reflectors the light was visible up to a distance of 28 km. The area was often swept by cyclone and gales and the journey between the ship and the beach was hazardous and unsafe. So for safe cargo handling, the company started construction of a pier in 1859 AD and completed the construction in 1861 AD. The pier was the starting point of the gradual development of Madras Port.

AIRWAYS

For thousands of years, people must have watched birds flying around them and dreamed of pleasures of flying. Many actually tried to fly. These "birdmen" strapped on wings and leapt from towers, trying to flap their arms. Most were killed in the deadly adventure. The first manned flight took place in Paris in 1783, in a hot-air balloon built by the French brothers Joseph and Etienne Montgolfier. Aviators also began to develop airships - balloons with a streamlined shape, pushed through the air by an engine. Balloons and airships are described as lighter-than-air aircraft because they float upwards in the heavier air around them.

The first heavier-than-air aircraft were gliders, built and flown in the nineteenth century by pioneers such as the German Otto Lilienthal. In the USA, two brothers, Orville and Wilbur Wright, were experimenting with kites and gliders. They made thousands of test flights in their gliders, gradually perfecting their controls. In 1903 they finally built an aeroplane, called Flyer 1, with a petrol engine. It made the first-ever powered, controlled aeroplane flight, which lasted just 12 seconds.

In the decade after the Wright brothers' historic flight, aviation became a popular sport. Race meetings and air shows were held, and pilots made historic long-distance flights. Aircraft technology steadily improved. Aviators began to understand how to build stronger aircraft structures

without increasing weight, wings which gave better lift and created less drag, and controls that made life easier for the pilot. The standard aircraft shape, with a tail section supporting a fin and tail plane, began to become popular. More efficient and powerful engines and propellers gave aircraft greater speed, endurance and reliability.

During World War I, aircraft became specialised for certain jobs, such as fast, manoeuvrable fighters and large, long-distance bombers. The first passenger airlines were formed in 1919, just after the end of World War I.

In the 1920s and 1930s aviation engineers began building in metal instead of wood, creating aircraft with strong tubular fuselages and monoplane wings. The first modern-style airliners, such as the Douglas DC-3, appeared in the mid-1930s. The jet engine was developed in the late 1930s, both by Hans von Ohain in Germany and Frank Whittle in Britain. The first jet aircraft flew in 1939.

How aeroplane came to Madras

D'Angeli, the Frenchman, owned a hotel in Madras named after him. It was located in the big corner building on Mount Road near Round Tana, where the Bata shoe shops is. He was spurred to build a plane of his own in Madras. Simpson, a coach-builders for decades, seemed the natural choice for workshop facilities. It was a simple structure, a light open body, an open cockpit, wings of canvas stretched taut on wire frames, an ordinary motor car engine fixed in front to rotate a propeller (Source: Padmanabhan R.A., 2001) .

D. Angeli was elated when the trial flights in Pallavaram proved successful. Improving on the first model, he fitted the plane with more and more powerful engines and, these too being successful, with a showmanship second nature to Frenchmen, arranged the public demonstration at Island Grounds, changing an entry fee. The Island Grounds demonstration by D'Angeli in March 1910 marks the dawn of the age of modern aviation in Madras city. The inauguration of the Madras Flying Club which was founded in 1930 and handled the first Tata Air Mail Plane in 1932 (Chapman, H.H., 1939).

Catalogue of exhibits

443) Name of the exhibit: Aeroplane –Airbus A 300-AB4 (Model) Acc. No. : Tr 18/2003 Provenance : India	444) Name of the exhibit: Aeroplane –Boeing 747 - 400 (Model) Acc. No. : Tr 19/2003 Provenance : India
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Rockets

We know that fire-emitting arrows were used by the soldiers in times of the Indian epics - *Ramayana*, *Mahabharata*. *Srirangapatna* is about 100 km from Bangalore, where India's satellites are made. In the eighteenth century AD, the rulers of the land, *Hyder Ali* and his son, *Tippu*, used rockets against the British. Made of iron tubes tied to bamboo sticks, the rockets were effective in the battles of *Srirangapatna* in 1792 and 1799 AD. The gunpowder inside the Indian rockets produced a jet of hot gases that propelled them over a short distance of less than three km. The thrust of the gases was too feeble, short-lived and uncontrolled to be used for any other purpose. Some of the rockets taken away by the British to England led to the production of a large number of similar missiles used in Europe. The rocket models have been preserved in the Woolwich Museum in England.

The Chinese are also known to have used such arrows against their enemies during the 13th Century AD. A mixture of charcoal, saltpetre and sulphur was used to prepare these arrows. During the early 1800's, Col. William Congreve of the British army developed the first ancestors of modern rockets. Such a rocket could also travel though it was as heavy as 27 kilograms. In 1903, a Russian teacher published his theory of the rocket power. The first modern rocket was made by an American scientist named Robert H. Goddard. Improvements went on and during World War II, Germany bombarded London with rockets. Next came to be developed high-altitude rockets in U.S.A. In 1947, a US engineer designed a rocket-powered aeroplane. It could fly at 7274 kilometres per hour. The first rocket-powered satellite was launched by Russia in 1957. It marked the beginning of the Space Age.

Rockets work much like a jet engine. They burn fuel in a combustion chamber to make hot gases. The hot gases escape backwards from a nozzle at an enormous speed. The force of these gases escaping backwards creates a similar force forwards (called reaction), which propels the rocket.

In rocketry, the fuel and oxygen-provider (oxidizer) are called propellants. The simplest kind of rocket has a solid propellant like a firework rocket. The solid-fuel rocket consists really of only the rocket casing containing the propellant. There is a hole through the middle of the propellant which lets it burn from the middle outwards rather than just from the end.

The most powerful space rockets, however, have liquid propellants and are much more complicated. Two common liquid fuels are kerosene (paraffin) and liquid hydrogen. Liquid hydrogen is hydrogen gas that has been cooled so much that it changes into liquid (just as steam changes into water when it is cooled). The most common oxidizer is liquid oxygen.

In a liquid rocket the propellants are pumped from their storage tanks into the combustion chamber. The pump is driven by a turbine, which is spun by gas produced in a gas generator. In the combustion chamber the fuel and oxidizer form an explosive mixture, which burns fiercely to produce gases that escape as a powerful jet.

Conclusion

We start this gallery with the prehistoric past and show the progress of industry and handicrafts till the very recent past. We hope that this journey in the progress of people from simple living with no tools, very crude stone tools, and not clothed or clothed with animals skins to the sophistication of the 20th Century will make our visitors stop and think if we could have done better things or the same things better. We give an idea of the progress achieved especially in Tamil Nadu, which is the cradle of civilisation as most historians now concede. We hope that this will be an entertaining and also an educative experience for young and old alike, especially for school and college students.

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A

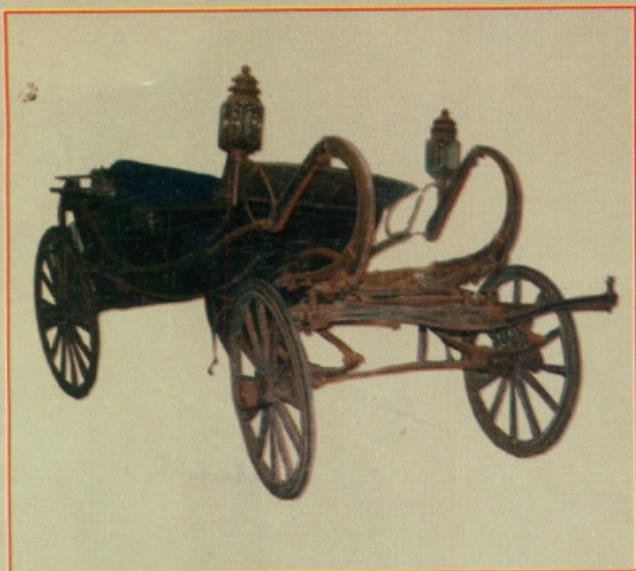


B

Waterways and Airways Models

A. Sl. No. 441, 442

B. Sl. No. 443, 444



Governor's Coach - Before Restoration



After Restoration - View with hood extended



Governor's Coach - After Restoration - View (as used on ceremonial occasions)

